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A GENETIC STUDY OF RHYTHM.

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CHAPTER I. PROBLEM AND METHODS.

§ 1. *Problem Stated and Defined.*

One of the most recent writers on rhythm¹ has affirmed that "Es gibt keinen schlechten Rhythmus." In other words, the perception of rhythm is present in completeness or vanishes entirely. This appears to be the opinion of the majority who have discussed rhythm,—either actually expressed, or implicit in their general presuppositions. But are there not well marked stages of relative perfection and complexity in the perception and production of rhythm?

The present Study is an investigation of this question with respect to one field of motor rhythm, that of rhythmical speech. Are all rhythmical forms equally simple psychologically; can the trochee and iambus, for instance, be regarded as equally difficult? Moreover, is any one verse-form constant and unalterable in structure; does it not also show different degrees of completeness and unitariness? *E. g.*, is the dactyl as produced by the young child as complex in structure as that produced by an older child; do the same objective variants appear in both cases; and do they bear the same relations to each other? Or, again, to put the question more concisely; can a correlation be made out between growth in complexity of the rhythmical form produced and mental grasp the producing subject?

There has been no attempt in what follows to bring the stages of this progressive growth in complexity of structure into connection with the history of the different metrical forms; for, in the first place, psychology has no concern with metrical questions as such; and, secondly, we have no more right to argue from the present psychological data back to an hypothetical past consciousness, than from that past to the present. Factors unknown to the present consciousness were undoubtedly effective in the past; and such factors would naturally vitiate any deductions drawn.

In the investigation of our main problem other questions arose, which seemed to demand special attention. These have been separately treated. They are: (1) the nature of pitch as an objective determinant of rhythm; its direction and constancy as compared with that of the temporal and intensive factors; (2) the relation of breathing to the spoken rhythm; (3) the conditions under which concomitant movements appear; and (4) the influence of chorus reading upon tempo,—a comparison of chorus-time with the average times of the individuals.

The present Study cannot be termed genetic in accordance

¹ Rhythmus und Arbeit, Margaret Kiever Smith. Phil. Stud., XVI, p. 292.

with the usual signification of that term, which emphasizes the concept of origins. But it is genetic in a secondary or derived sense; for it seeks to determine the essential constituents of rhythm, and the variations they undergo in the development of the more complex from the simpler forms.

The genetic theories have been chiefly concerned to explain the origin of rhythm. They have been content, as Meumann¹ justly says, to furnish an opportunity for the entrance of the rhythmic consciousness, but have made no attempt to analyze the psychological and physiological mechanism of this consciousness; all this they have taken for granted.

Such theories have, as a rule, relegated the working of the causal principle to the remote past. Hence they are not only safely entrenched against the criticism which experimental and introspective facts might seem to warrant; but they are also unable to appeal to introspection or experiment for support. Consequently, genetic theories of this type must depend upon historical data for their verification. Even when connected with metrical investigations they can never have greater weight than that which is accorded to speculative hypothesis. Even the recent interesting investigation of Bücher has the defects common to genetic theories² of the type mentioned.

The genetic method, as it is here used, has its chief value in the solution of the problems offered by the psychological complexes themselves. Rhythm, for the adult consciousness, is so interwoven with associations of all sorts; is such an unitary and unanalyzable experience; that it is well nigh impossible to disentangle the essential from the non-essential constituents. But we can hope, through a judicious use of the genetic method, to reach a more satisfactory analysis of the objective constituents,—temporal, intensive and qualitative—and of their relations to each other; by correlating these with increase in ability to attend and to apperceive we can also hope to show more clearly the intrinsic nature of rhythm.

The danger of false interpretation of such data is greater than it is in the case of adult psychology. This is due to the tendency of all observers to read their own experience into the observed phenomena. The experience of an observer is naturally farther removed from the child's than from that of another adult. Neither can observations in this case be verified by the introspective report of the subject, as in the problems of adult psychology. But with carefully collected data, and conservative interpretation, the danger can, we think, be reduced to a

¹ Untersuchungen zur Psych. u. Ästhetik des Rhythmus, Phil. Stud., X, p. 252.

² Arbeit und Rhythmus, Zweite Aufl., Leipzig, 1899.

minimum. The investigation of Bolton¹ sought in another way, *i. e.*, by the study of subjective rhythmisation, to reduce the problem of the psychological constituents of rhythm to its simplest terms. While this method gives us the simplest conditions under which grouping may occur, it cannot show the relation of the simple or subjectively conditioned rhythm to the more complex and objectively conditioned.

§ 2. METHOD.

The age of the subjects—children of the first, fourth and seventh grades—determined the method. It was necessarily objective,—a study of their ability to produce the different rhythmical forms.

Those who have worked with children know that the normal child is incapable of introspection. Even if an occasional child might be able to give introspective data, these would have slight scientific value; for every sign is caught at, as a suggestion in accordance with which a report may be given. The answers returned to the simple question of 'what form pleased them most' were contradictory in so many cases, that from the answers given by sixty children at several different readings not enough reliable material was obtained to base a single conclusion upon.

The investigation has been confined to the spoken rhythm. It was desired later to test children of the same age on the ability to tap the same forms. The time, however, failed for this, except in the case of several particularly unrhythmical subjects. Thus a satisfactory comparison of the two forms of motor rhythm, which would be highly desirable, cannot be made. The experiment was performed in two ways. (1) A successive number of readings were given by a comparatively large number of children. An analysis was made by the experimenter during and immediately after the production of each form. (2) The same forms were given by three children; a girl of seven, and two boys of nine and eleven respectively, and the Rousset microphoned was used for analysis. The first series of tests was made on both German and American children; the second on American alone.

Method I. The children serving as subjects were taken from the Zentral-Schule and Sanderschule of Wuerzburg, and the Central and Grammar Schools of Ithaca. They were on the whole normal children, neither exceptionally bright nor exceptionally dull. The teachers were requested to select five boys and five girls from each of the three grades before mentioned. They were to give, in their selection, as great variety of temperament as their school afforded,—the plodding and faithful student as well as the careless and listless,—but were

¹ Rhythm, *Amer. Jour. of Psych.*, VI.

to except any who might be abnormally dull. By such selection we hoped to obtain results that might serve as typical. The children entered into the experiment with a zest that had hardly been expected. The syllable *mi* for the German children, *me* for the English, was written in five lines of six syllables each; care was taken to keep the syllables of the same line equidistant. The experiment was carried on in a room separated from the class room. The children were admitted singly, in order to avoid the influence of one upon another. They stood during the experiment; the paper being placed so that, as the child stood in a comfortable position for reading, he was also in a good position for the experimenter to note all concomitant movements. A position directly at the side of the experimenter was found to be the most favorable. The children were first requested to read the lines in the manner that seemed most natural to them. The purpose of the free reading was to determine whether on the motor side a subjective grouping would appear such as that already noted by Bolton¹ on the sensory; and, if so, under what conditions. Miss Smith² has since noted such grouping in her investigation at Zurich: the present investigation was begun before this appeared.

The children were later asked to emphasize particular syllables, thus throwing the whole into certain rhythmical patterns. Every expression which might influence them as to the manner of emphasis was carefully avoided, as one of the questions to be investigated was the nature of emphasis or accent and its psychological meaning. The forms required were (*a*) the first emphasized; then every other one; (*b*) the second, then every other one; (*c*) the first, and every third following; (*d*) the third, and every third following that. The order in which these directions were given was continually varied, in order to avoid the favoring by practice of any one or more forms. The time, intensity and qualitative differences were noted by the experimenter, together with any other facts, such as movement or breathing, which might bear upon the investigation as a whole; and the time occupied by the reading of the series of thirty syllables was taken with a stop-watch. A single syllable was repeated, in order to get material which was not already rhythmically ordered, as we desired to find what must be added to a series of disconnected sensations in order to make

¹ *Op. cit.*, pp. 203 ff.

² *Op. cit.*, p. 282. "Es giebt also ebenso einen Zwang zu motorischer Rhythmisirung fortgesetzter Bewegungen wie zum subjectiven Rhythmisiren von Schalleindrücken die in gleichen kurzen Zeiten aufeinanderfolgen." In one case, where the subject failed to raise the weights *regularly*, there was no perception of rhythm. Subjects when asked to read staccato broke the series into groups of four or six syllables.

it a rhythmical whole as well as to see if any one form of grouping appeared more frequently than others. Consequently, words which already possess a primary rhythm, and verse with its complicated rhythms, could not be used. It was also necessary to employ the *same* syllable, in order to avoid all inequalities in the articulation.

It might be objected that deductions cannot be made from the grouping of such material as this to the grouping of verse. To this it may be replied that, in so far as the primary rhythm governs verse, the same principles hold as in the grouping of these simple meaningless elements. It is the modifications introduced by what Sidney Lanier¹ terms secondary and tertiary rhythm, *i. e.*, the rhythms of word-accent and thought, that change the primary rhythm, giving verse its special beauty and flexibility. Moreover, in the experiment with the American children of the fourth and seventh grades, the syllables were frequently involuntarily modified so as to read *meet me*, *me*, or *meet me*, thus introducing a secondary rhythm.

Method II. From the American children, subjects were chosen who had taken part in the previous experiment. The method was modified by using the Rousselot microphone. The record of the rhythm was traced on the drum of a Ludwig-Baltzar kymograph; synchronously a breathing curve was registered. For this the Harvard pneumograph, adjusted around the chest, was connected with a Marey tambour. The time was marked in fifths of a second by a Jaquet chronometer. The Rousselot microphone consists of a metallic mouthpiece connected by a rubber tube with a cylindrical metallic box in which three carbon tips are suspended. The adjustment is made by means of a screw at the end of the box opposite the junction with the tube. The screw, through its connection with a metallic spring to which one of the carbon tips is attached, regulates the distance between the tips. The wires connecting the tips with the electrical circuit enter through the top of the box. In the same circuit is a small electro-magnet, above which is a drumhead of goldbeater's skin, to which is attached a writing point. The changes in the current of air entering through the tube make and break the current. The intensity of the sound is indicated by the amplitude of vibration of the writing point; the pitch by the number of vibrations in a given unit of time; the duration of syllables and pauses by the length of the records and the length of the intervals. It was found necessary to use a more explosive syllable than *me*, and *be* was substituted as being nearly equal in time. The microphone responded with the greatest precision when the level of the

¹ The Science of English Verse, N. Y., 1888.

mouthpiece was slightly below the mouth of the child. The children stood as before. The number of syllables was not limited, as in the previous experiment. All of the involuntary series were taken first, then the complex groupings in varied orders. Though the microphone responded as readily as could be expected, the restrictions of position, etc., decreased the child's sense of freedom; concomitant movements were very seldom marked, while none of the zest that had been shown in the previous experiment was observed. Each method had its peculiar advantages and disadvantages. The chief advantage of the second was that it furnished an accurate record of the rhythm as it was given. The disadvantages were that with fewer children there was less variety in form, and that individual characteristics might easily be confused with general. The feeling of restraint that attended the use of the microphone could not be eliminated, and militated against a natural grouping. The experiment was regarded as a task, while in the earlier experiment the children gave themselves up freely to the swing of the rhythm. As already shown, the first method had the advantages of a freer rendering on the part of the children and greater possibilities for variety in form; its disadvantage was that, as we possessed no objective control, there was liability of error in the analysis of the experimenter. But this liability to error in analysis was counterbalanced, in a measure at least, by the facts that for many of the series two experimenters were present, and that a large number of observations were made. The second method, then, can be considered as a control of or check upon the first.

CHAPTER II. RESULTS.

§ 1. *Involuntary Grouping.*

Results from Method I. The series were separated by intervals of a week. The first series were given before the children had learned the complex forms; but the practice of the previous week had doubtless some influence upon the succeeding series; this reached its height in the third series. Later, probably because of the monotony of the work, there was a return to the simpler forms of the first series. The order of succession, regularity or irregularity in the occurrence of a pause, is the primary objective determinant. A four group form divided into twos occurred twice; and $\dot{\text{p}} \text{p} \text{p} | \dot{\text{p}} \text{p} \text{p}$ was noted once; otherwise, with the exception $\dot{\text{p}} \text{p} \text{p} | \text{p} \text{p} \text{p}$ that the end of the line was frequently marked by a longer pause and a falling voice, the three-grouping was the largest observed. We will note first those cases, in which the syllables varied neither in time, intensity nor pitch, although differentiated by the regu-

lar or irregular occurrence of a pause. The results can be tabulated under four rubrics: (*a*) no observable regularity in the occurrence of a pause; (*b*) pauses after each syllable of equal duration; (*c*) pause after every second syllable noticeably longer than the intervening; (*d*) the longest pause after every third syllable.

TABLE I.

Irregular pauses.			After each syllable.			After every 2nd.			After every 3rd.			
Gr. I.	Gr. IV.	Gr. VII.	Gr. I.	Gr. IV.	Gr. VII.	Gr. I.	Gr. IV.	Gr. VII.	Gr. I.	Gr. IV.	Gr. VII.	
2	4	6	9	3	9	0	2	2	0	0	0	G. B.
19	18	23	19	18	22	19	18	22	19	18	23	
2	3	5	2	0	0	0	1	23	0	0	0	G. G.
15	20	25	15	20	25	15	20	25	15	20	25	
3	5	0	3	6	2	7	2	2	1	1	0	A. B.
22	22	18	22	22	18	22	22	18	22	22	18	
4	1	0	0	4	3	6	7	5	1	3	1	A. G.
22	22	19	22	22	19	22	22	22	22	22	19	

G. B. indicates German boys, G. G. German girls, A. B. American boys, A. G. American girls. It was impossible to obtain exactly the same number of readings from each class; for, on the appointed day, one or even two of the five children might be absent, and nothing remained but to proceed with the experiment: hence the results are given in fractional form, the numerator representing the number of occurrences, the denominator the total number of readings.

In the first case all perception of rhythm failed, although the rate of reading was sufficiently rapid for rhythmical grouping to have occurred. The irregular cases are distributed through all the five series. Had the irregularities been due to a difficulty in the articulation of the syllables, we should naturally expect that practice would cause its disappearance in the later series. Another peculiar fact is that the number of irregular cases is greater among the upper grades of the German children than among the lower. This, in the light of the fact that movements regularly repeated tend to become automatic, would seem to show that the irregularities in this case cannot be explained on the ground of irregularities in motor adjustment. The most plausible explanation is that the series did

not possess sufficient interest to hold the attention, and that the irregularities in the rhythm were due to the irregular pulses of attention.

In case (*b*) we have what Miss Smith terms "einfachen" or "Urrhythmus." "Es ist keine Frage dass auch in der blossen Aneinanderreihung von völlig gleichbetonten Silben, zwischen denen keinerlei Gruppierung mehr hergestellt wird, ein Rhythmus liegen kann. Ebenso kann eine Zeile eines Liedes in lauter ganz gleichen Noten voranschreiten, und doch rhythmisch sein. Diesen Fall bezeichnet die Verfasserin als einfachen oder Urrhythmus."¹ This Lanier calls "primary rhythm."² "If equal or simply proportioned intervals of time be marked off to any of our senses by any recurrent series of similar events, we may be said to perceive a primary rhythm through that sense." "But this primary rhythm may be considered a sort of primordial material, which the rhythmic sense of man always tends to mould into a more definite, more strongly marked, and more complex form that may well be called secondary rhythm."

There is no apparent correlation between age and the appearance of this form in the free reading. The cases are fairly equally distributed among the grades. The pronunciation of each syllable was frequently accompanied by a forward movement of the head or of the whole trunk. With the first grade children, when attempting to produce an anapæstic or dactylic form, a lapse into the primary or uncompounded rhythm was often noted. A frequent peculiarity of such cases was a regularly recurring pitch, time, or intensive difference, together with pauses of equal duration at the end of each syllable. It was doubtless due to a breaking down of the complex group in which certain characteristics of the complex form were still retained. These cases throw light on the mental processes underlying rhythm. The most plausible explanation of the phenomenon seems to be that one wave of attention did not take in the total group, so that each single syllable was the object of one act of attention. Although the different syllables were still compared as to time, intensity, etc., it was a mediated comparison of the same nature as that performed by the adult in his comparison of the several groups of a long series. This transition from immediate to mediate comparison could have been brought about either by the slow rate of succession, or by the too great span of the group as to number, or by the intrinsic difficulty of making a comparison; any one of

¹ *Op. cit.*, p. 198.

² *Op. cit.*, p. 62.

these three factors would have brought about the result. Wundt¹ denies that this alternate series of syllable and pause, movement and rest, attention and inattention constitutes a rhythm. "Gleiche Eindrücke in gleichen Pausen stattfindend wirken ermüdend, aber niemals rhythmisch. Damit ein ästhetisches Gefallen entstehe, müssen mindestens zwei verschiedene Eindrücke, Hebung und Senkung des Klangs, wie in $\frac{2}{8}$ Takt, in regelmaessigem Wechsel einander folgen, mag nun dieser Wechsel durch die Eindrücke selbst oder bloss durch die subjective Betonung erzeugt werden." In this passage, the term 'rhythmical' clearly connotes capability of arousing an æsthetic feeling. This seems to be an unwarrantable limitation of meaning. If æsthetic value is to be made a criterion of rhythm, then frequently the complex forms must be regarded as unrhythmical; for there are not a few instances in our own experiments, as well as in those of others, in which a form possessing all the objective marks of a highly complex rhythm and evidently perceived as such was either subjectively indifferent or positively unpleasant. The feeling of æsthetic pleasure is too subjective a criterion to apply to such an objective and universal fact as that of rhythm. In the present paper, rhythm is used to cover all cases of regularly recurring impressions derived from the modalities of audition and movement.

The first step toward a unification of the separate impressions is that noted in cases (*c*) and (*d*). Here two or three syllables of equal duration, pitch and intensity, are separated from those following by intervals noticeably longer than the intervals between the given syllables. This form was characteristic of the free reading of the seventh grade boy by Method II; *cf.* record for Charles, Method II, involuntary grouping. It scarcely appeared in the reading of the German children. When there was a rhythm, there was generally a subordination of one syllable to another, by means of pitch, intensity, time, or a combination of these. The form shown in case (*d*) was far less frequent than that of case (*c*). Many of Bolton's² subjects found difficulty in throwing auditory sensations into groups of three; our own (*cf.* results on pitch) never grouped in threes unless there was an objective ground for so doing. The form shown in case (*c*) frequently resulted when the younger children attempted to give the more complex rhythms. This form was also characteristic of the free readings of the two negro children, a boy of the first and a girl of the fourth grade. For the hearer, their reading was very rhythmical. The time values

¹Grundzüge der physiologischen Psychologie, 4e Aufl., 1893, II, p. 237.
²*Op. cit.*, p. 216.

for these series were greater than those for the irregular and the primary forms. We may presume, then, that the syllables were given their original length, and that the interval between successive pairs was considerably lengthened. One wave of attention could compass the group, and no attempt was made to compare syllable with syllable. These results do not tally with the generally accepted rule for the subjective grouping of auditory sensations, which affirms that there is no tendency to group successive sounds until some one is heard as more intensive than the others. Have we here a purely physiological phenomenon, which has no parallel in sensation; in other words, is such a series perceived as rhythm, or is there merely a rhythm in the motor mechanism? The result might have been the outward expression of the natural breathing rhythm, the expiration lasting during the two syllables and the intervening pause; but such a curve, as will be seen in the discussion of breathing, is not the normal rhythm of respiration. There is another possible explanation. It is that, although the syllables presented equal difficulties for the organs of articulation, etc., and there was nothing in the nature of the syllables themselves or the child's attitude towards them to raise one in importance above another, there was, nevertheless, a tendency present towards the unification of the large number of separate syllables, by their division into a number of smaller groups. Several syllables fell within one pulse of attention, and the pause which corresponded to the zero-point of the attention wave was consequently longer than the intervening pause. Meumann and Bolton dealt only with the grouping of auditory sensations. Doubtless in that fact is to be found a partial explanation of the disagreement in results; still (*cf.* the section on pitch) subjects frequently broke up series of equal sounds into groups of two, four, six, eight, etc., syllables, without giving any one more intensity, duration or pitch than other. There was, according to their statement, no recurring intensive difference to cause the grouping for the perceiving subjects. These cases were interspersed among series that differed objectively. The conditions here would seem, then, to be more favorable for a correct analysis of the perception of rhythm than they were in the experiments of Bolton. For here the series which had no objective mark of difference lost in subjective intensity in contrast with objectively conditioned rhythm.¹

The breaking up of the series of separate impressions into groups of two or three equally accented syllables was an ad-

¹ One of Miss Smith's subjects found in learning nonsense syllables that "der Rhythmus der Betonung spielte keine so grosse Rolle wie Gruppierung oder Theilungen." See *op. cit.*, p. 256.

vance upon the primary rhythm; but the group lacked unity. The manner in which a closer grouping was effected varied with the individuals, and there were also indications of race difference; but regular temporal, intensive, and qualitative variations were the objective factors. The longer, higher and louder tones occurred together or were used interchangeably. Meumann discusses the interchangeability of time and intensity in the estimation of time intervals under the principle of "Stellvertretung."¹ The accent, intensive, temporal or qualitative, was given as shown in the Table. Accent is used throughout as synonymous with emphasis, and is not restricted to increase in intensity.

TABLE II.

Qualitative.			Intensive.			Temporal.			
Gr. I.	Gr. IV.	Gr. VII.	Gr. I.	Gr. IV.	Gr. VII.	Gr. I.	Gr. IV.	Gr. VII.	
6	9	3	0	2	1	1	1	2	G. B.
19	18	23	19	18	23	19	18	23	
10	16	15	0	5	5	0	6	6	G. G.
15	20	25	15	20	25	15	20	25	
2	3	2	3	7	6	5	5	5	A. B.
22	22	18	22	22	18	22	22	18	
5	2	1	3	6	5	4	4	5	A. G.
22	22	19	22	22	19	22	22	19	

G. B. indicates German boys, G. G. German girls, A. B. American boys, A. G. American girls. The numerators give the number of occurrences, the denominators the total number of readings.

The most noticeable fact shown by the Table is the greater number of cases of qualitative accent among the German children. The pitch intervals were also as a rule greater than with the American children. The number of accented readings, intensive, temporal and qualitative, was greater among the German girls than among the German boys. Both American boys and girls of the seventh grade gave accented readings more frequently than the German boys of the same grade. There were a greater number of irregular readings given by the German boys of the seventh grade than by the younger children.

¹ Beiträge zur Psychologie des Zeitbewusstseins. Phil. Stud., IX, pp. 303 ff.

Cf. with this result, Table I, above. There seems to be a curious contradiction here. Other things being equal, the irregular readings disappeared with increased age, and one might reasonably expect to find an increased tendency to accented grouping among the older boys; but the explanation given in the account of irregular readings doubtless holds here.

It is a question how much a conscious imitation of the complex forms had to do with the manner of free reading. We discovered it in the case of one of the American boys of the seventh grade. When questioned he admitted that he was purposely giving a certain form because it pleased him. Even after throwing out such cases, which were not frequent,—knowing the characteristics of children, we were able to detect any such distortions,—there is a noticeably greater tendency toward a strongly accented rhythm in the free readings given by the older children than in those given by the first grade. The first syllable was almost invariably the accented syllable; the reverse occurred but three times among the American children and twelve times among the German.

Results from Method II. To avoid the influence of the complex forms upon the natural grouping, all the involuntary series were taken first. This order would have been followed in the first instance; but the children would then have taken no interest in what, from their point of view, would have been a stupid and meaningless task. For this reason it was necessary to ask for the restrained and free readings on the same day. But the microphone presented difficulties enough to make the desirable arrangement possible, and yet preserve the interest of the children. On the other hand, the use of the microphone was too difficult to be accompanied with much pleasure.

R. A. Girl, first grade, self-controlled to an unusual degree, susceptible to rhythm. The figures given are the averages of the absolute time values of the successive series. Pitch was uniform throughout, and the intensities varied but slightly, and only in the manner indicated in the Table. Type of grouping was clearly primary, uncompounded, occasionally irregular. Series (3) will be discussed in detail as it has an important bearing on the genesis of the complex rhythm.

We note that the time of both syllable and pause falls within the most favorable time for rhythmical grouping (.5 to .2 second). The grouping falls under either the irregular or the primary type, with the exception of Series (3). The breathing record is interesting in this connection. Each syllable corresponds to an expiration, each pause to an inspiration; *i. e.*, a full inspiration was taken after every syllable. (*Cf.* breathing records.) This type of breathing was characteristic of *R. A.*'s reading, restrained as well as free.

TABLE III.

	Syllable.	Pause.	Intensity and Pitch.
Av. values for series in sec.	(1) .408	.458	No variations in pitch or intensity.
	(2) .298	.454	Intensities of the syllables equal; each syllable begins with greater intensity and then gradually grows less; no variation in pitch.
	(3) .282	.346	Important for genesis of rhythm. Cf. discussion following.
	(4) .463	.39	No variations in intensity or pitch.
	(5) .287	.45	" " " " " "
	(6) .332	.4	" " " " " "

Series (3) was taken on the same day as (1) and (2); the microphone was working unusually well. *R. A.* began with the primary form; suddenly we heard a marked change in her manner of reading. It was trochaic. Nothing that we could observe had occurred to bring about the change. We could only refer it to the ease with which she was reading, and the practice that series (1) and (2) had given her; although in the free readings following she never reverted to this type. It is also to be noted that at the same time in which the rhythm became trochaic the breathing curve was compounded; *i. e.*, expiration lasted during the interval occupied by two syllables and the intervening pause. The complete results are given for this series. The breathing record is paralleled with that for the spoken rhythm. The variations of amplitude of vibration within the rhythmical unit at no time exceeded 1 mm.; therefore only the relative deviations in intensity can be given.

It is probable, had it been possible to make the estimations perfectly exact, that the slight deviation between the time for the breathing and the spoken rhythm would disappear. It is to be noticed that compounding in breathing occurs before there is any evidence of a grouping in the spoken rhythm, but that immediately thereafter the second syllable becomes shorter and less intensive than the first, although the intervening pause is fully as long as that following. Next, the second syllable is shortened and the pause following it is lengthened. This markedly trochaic grouping lasts in its most perfect form, as shown in the * groups, for only three groups; following upon this, there is either no difference in the length of the pauses, or an unvarying intensity, *i. e.*, a less perfect grouping. While we cannot conclude from this one record that it presents the exact order in which a complex grouping is brought about, it clearly gives a possible genesis, and shows how closely related breathing and grouping are. There is no evidence as to which

TABLE IV.

Breathing Record.			Spoken Rhythm.		Pitch and Intensity.
Exp. sec.	Insp. sec.	Height mm.	Syll. sec.	Pause sec.	
.419	.233	1.5	.35	.337	No variation in pitch or intensity.
.466	.166	2	.325	.35	
.5	.266	2	.3	.325	
.5	.33	2	.3	.4	
.466	.266	1.5	.375	.325	
.6	.233	1.3	.45	.275	
.4	.283	3	.325	.4	
.466	.33	2	.275	.325	
1.566	.33	2	.325 (a)	.4	
			.35 (b)	.35	
.966	.45	2.25	.3 (a)	.4	Intensity of (b) less than that of (a).
			.125 (b)	.325	
1.016	.316	.266	.425 (a)	.175*	" " " " " " " "
			.125 (b)	.525	" " " " " " " "
1.66	.316	2	.4 (a)	.175*	" " " " " " " "
			.25 (b)	.4	" " " " " " " "
I	.316	2.25	.35 (a)	.275*	" " " " " " " "
			.225 (b)	.4	" " " " " " " "
.95	.35	2.75	.25 (a)	.375	" " " " " " " "
			.15 (b)	.5	" " " " " " " "
1.03	.266	2.5	.25 (a)	.35	" " " greater than that of (a).
			.225 (b)	.425	" " " equal to " " "
I	.283	2.75	.375 (a)	.275	" " " equal to " " "
			.175 (b)	.45	" " " less than " " "
1.16	.3	3	.25 (a)	.35	" " " less than " " "
			.175 (b)	.215	" " " less than " " "
I	.3	3	.45 (a)	.175	" " " equal to " " "
			.2 (b)	.425	" " " equal to " " "
I	.316	2.25	.5 (a)	.175	" " " " " " " "
			.2 (b)	.425	" " " " " " " "
.85	.33	2.33	.375 (a)	.2	" " " " " " " "
			.2 (b)	.4	" " " " " " " "

stands in the relation of cause and which of effect unless priority of compound breathing might be taken as an indication that change in breathing was the cause of the grouping. It is more probable that the change in breathing was due to some psychical factor which may in turn, enforced by the breathing, have brought about the decided grouping. The state of *R. A.* at the time of the record was evidently one of pleasurable interest in a not too difficult activity. There was a pendular movement of the whole body, such as was seldom marked in the experiments with the microphone, although found very frequently in the readings given by Method I. One might venture, then, to posit as a cause for the grouping the fact that the attention was directed upon the series as a whole and not upon the articulation of each separate syllable.

H., a boy of ten, fourth grade; restless and incorrigible in school; while interested in the experiments, was unable to direct his attention long upon any one thing. (The first three series of the free readings were given by a boy of another type; but he was not available later, and *H.* came to the laboratory in his place.)

TABLE V.

	Syllable.	Pause.	Pitch and Intensity.
Av. values for series in sec.	(1) .588	.136	No variation in pitch or intensity.
	(2) .363	.13	
	(3) .573	.175	
	(4) .35	.276	
	(5) .442	.191	
	(6) .488	.173	
	(7) .402	.192	

The pauses are invariably shorter than in the reading of *R. A.* The relative times have changed. While in *R. A.*'s reading the syllable and pause varied but slightly in duration, in the reading of *H.* the pause is much shorter. There is scarcely any variation in the duration of the several pauses. The rhythm is throughout of the purely primary type.

The breathing was very different from that of *R. A.*; an expiration lasted on an average for eight syllables, although as few as five and as many as ten were at times included in one expiration. The inspiration was short, corresponding to the longer pause in the spoken rhythm. The grouping was also of the same general form; series of five to ten syllables, varying very slightly as to time and not at all as to intensity or pitch, were separated by short pauses and followed by a longer pause, varying in length from .3 to .5 second.

C. D.; eleven; seventh grade; leads his class; very painstaking.

TABLE VI (a).

Primary Rhythm.

	Syllable.	Pause.	Pitch and Intensity.
Av. values for series in sec.	(2) .57	.158	No variations in pitch or intensity.
	(3) .548	.142	
	(7) .75	.137	

TABLE VI (b).
Two Grouped Rhythm.

Syllable.	Pause.	Pitch and Intensity.
(1) (a) .59	.084	No variations in pitch or intensity.
(b) .56	.163	
(5) (a) .565	.1	
(b) .532	.181	
(6) (a) .7	.102	
(b) .69	.221	
(7) (a) .555	.075	
(b) .495	.138	

The breathing was of the type already mentioned in the case of *H.* There were none of the irregular fluctuations which appeared in *H.*'s reading. While pitch and intensity held the same throughout the series, there was a slight tendency to a two-grouping in series (1), (5), (6) and (7). In these series the first syllable of the group was slightly lengthened, as was also the pause at the end of the second syllable; *i. e.*, they approached the trochaic type. In the other series, the larger groups which corresponded to the breathing rhythm were made up of an irregular number of syllables, seven, nine, or eleven. The separate syllables varied but slightly in duration. They were examples of the primary rhythm. On the whole, *C. D.* shows a greater tendency to rhythmical grouping in his free reading than does either *H.* or *R. A.* of grades four and one.

It is apparent at a glance that the results gained by Method I gave a greater variety in manner of grouping; pitch and intensive differences were there frequently present, whereas here they fail entirely, except in series (3) for *R. A.*, which showed slight intensive variations.

The reason for the disparity between the results of the first and second method can be accounted for as follows. (a) The practice with the restrained or complex groupings exerted an influence on the free readings of the succeeding week, in the first experiment; (b) with the microphone, there was a certain constant resistance to be overcome; this tended to bring about an automatic regularity and uniformity in the articulation of the syllables, and the result was the primary form; (c) the resistance of the microphone was so great that attention was directed upon the articulation of the syllables. The freedom and spontaneity that characterized the readings, as given by Method I, were entirely wanting. This would militate against the perception of rhythm. Miss Smith points out similar in-

stances.¹ "Obgleich (beim einfachen Rhythmus) in diesen Versuchen die Bewegungen des Aussprechens taktmaessig waren, hat die Versuchsperson wegen der Schwierigkeit desselben keinen Rhythmus irgend welcher Art empfunden. Die ganze Aufmerksamkeit wurde auf die Qualitaet der Leistung gerichtet, und wie vorher bei den Gewichts-und Schreibversuchen entstand auch hier die Empfindung des Rhythmus erst dann, wenn eine gewisse Gewandtheit gewonnen worden war."

(d) According to the arrangement of Method I, the syllables were written in five lines of six syllables each. As they thus stood, they were more readily divided into groups. One of Miss Smith's subjects reported that, as he readily divided a visual series into groups of three, so three syllables made for him an unity easily perceived. This may also have been a factor which helped to bring about the divergences in the results of our two Methods.

Summary.

1. An involuntary grouping may arise either through a regular variation in time relations, or by regular intensive or qualitative variations. The earliest form, in order of priority, seems to be the primary; following that is the two-grouping with equal syllables, but regular variations in the duration of the pauses; then comes the two-grouping by means of temporal, intensive or qualitative subordinations among the syllables. 2. The temporal subordinations are the first to appear in involuntary grouping; intensive or qualitative changes come later. 3. Grouping increases in completeness with increased development of the child. 4. There seems to be a tendency in the motor mechanism toward automatic regularity which furthers the production of rhythm. 5. Breathing appears to stand in a functional relation to the rhythm. 6. Involuntary grouping occurs (a) when the attention is directed upon the series as a whole; (b) when an incentive is present to lighten the work or perception by separating the total series into smaller and easily perceived groups. This equal division of attention (in pulses of natural length) gives the double guarantee of a perception of all the members of the series with a lightening of the work of perception. (c) When a regularly recurring activity tends to bring about a rhythm in the motor mechanism; (d) when there is no feeling of bodily discomfort or strain to distract the attention. 7. Grouping disappears (a) when the effort of articulation is so great that attention is necessarily directed upon the act itself; when, *i. e.*, the attention is abstracted from the succession to the individual members; and (b) when the time equivalent to the normal pulse of attention is exceeded by the total duration of two syllables.

¹ *Op. cit.*, pp. 233, 254, 290.

§ 2. VOLUNTARY GROUPINGS.

For the sake of convenience, the results are given in the order: trochaic, iambic, dactylic, anapæstic groupings, although, as before stated, the order was constantly varied during the course of the experiment. The terms trochaic, iambic, dactylic and anapæstic are not used in the metrical sense, but as convenient terms for forms of restrained groupings of two and three syllables, in which a certain syllable of each group is emphasized. Grouping was, however, never mentioned; it arose naturally and involuntarily from the regularly recurring emphasis.

Method I. As in the free readings, the judgments of the experimenter were only relative; *i. e.*, one syllable was judged longer or louder than another. We attempted to note pitch differences exactly. While it would have been desirable to note time and intensity differences under the three categories of just noticeably present, present, and marked, we found that the distinctions had not been and could not be accurately enough made, in every case, to warrant such a classification. Notice was also taken of the position and character of the pause, the presence or absence of concomitant movements and their general character, together with the time for the whole series. The concomitant movements and time values of the different forms are discussed in a later Section.

Because of the unequal number of readings in the different classes, Tables of presence and of absence have been given. The distinctive differences in the readings of the three grades are clearly brought out by a comparison of these two Tables. In the case of qualitative differences, 'marked' designates intervals of a fourth or more; 'inverted' signifies that the falling inflection occurred, where the rising is ordinarily given, or *vice versa*, or that the relations of long and short were reversed, etc.

Total for Five Series of Trochaic Readings.

TABLE VII (a).
Pitch Variations. (Present.)

I.	IV.	VII.	
15 p. 3 m. 1 i. 0 ir.	10 p. 7 m. 0 i. 1 ir.	10 p. 10 m. 1 i. 2 ir.	G. B.
17 p. 0 m. 0 i. 1 ir.	10 p. 9 m. 3 i. 0 ir.	17 p. 3 m. 3 i. 0 ir.	G. G.
4 p. 0 m. 1 i. 0 ir.	12 p. 2 m. 0 i. 0 ir.	12 p. 2 m. 0 i. 0 ir.	A. B.
7 p. 1 m. 1 i. 0 ir.	16 p. 2 m. 0 i. 0 ir.	13 p. 0 m. 2 i. 0 ir.	A. G.
43 p. 4 m. 3 i. 1 ir.	48 p. 20 m. 3 i. 1 ir.	52 p. 17 m. 6 i. 2 ir.	Total.

p., signifies present; m., marked; i., inverted; ir., irregular.

TABLE VII (b).
Pitch Variations. (Absent.)

I.	IV.	VII.	
0	1	1	G. B.
1	1	2	G. G.
16	8	4	A. B.
14	3	4	A. G.
31	13	11	Total.

(1) The tendency of the German children toward a qualitatively determined rhythm is shown more clearly in the Table of absence than in that of presence; but this difference between the German and American children decreases with increasing age. (2) Intervals of a fourth or more occur more frequently among the German children. (3) Cases of inversion were scattered through all the series; the voice-fall being falling-rising, instead of rising-falling, as generally found in trochaic grouping. Inversion in pitch is not a function of age.

TABLE VIII (a).
Intensity Variations. (Present.)

I.	IV.	VII.	
7 p. 4 m. o i. o ir.	11 p. 4 m. o i. o ir.	18 p. 2 m. o i. o ir.	G. B.
6 p. 2 m. i i. o ir.	8 p. 7 m. o i. o ir.	14 p. 3 m. o i. o ir.	G. G.
3 p. 0 m. o i. o ir.	18 p. 0 m. o i. o ir.	9 p. 4 m. o i. o ir.	A. B.
10 p. 2 m. o i. o ir.	16 p. 2 m. o i. o ir.	15 p. 2 m. i i. o ir.	A. G.
26 p. 8 m. i i. o ir.	53 p. 13 m. o i. o ir.	56 p. 11 m. i i. o ir.	Total.

TABLE VIII (b).
Intensity Variations. (Absent.)

I.	IV.	VII.	
8	4	3	G. B.
6	8	7	G. G.
18	4	5	A. B.
10	3	0	A. G.
42	19	15	Total.

It was often difficult to distinguish between a slight rise in pitch and a slight increase in intensity. Repetition was then required.

The dissimilarity between Germans and Americans is not so marked as in Table VII. The first grade Americans are distinctly less rhythmical than the German children of the same age. The correlation between increased intensive variations and increased age is even more marked than the same correlation in the case of pitch. Inversion is far less frequent in intensity than in pitch.

TABLE IX (a).
Temporal Variations. (Present.)

I.	IV.	VII.	
4 p. 0 m. 0 i. 0 ir.	9 p. 1 m. 0 i. 0 ir.	14 p. 0 m. 0 i. 0 ir.	G. B.
3 p. 1 m. 0 i. 0 ir.	7 p. 4 m. 1 i. 0 ir.	14 p. 3 m. 1 i. 0 ir.	G. G.
4 p. 0 m. 0 i. 0 ir.	20 p. 0 m. 0 i. 0 ir.	10 p. 4 m. 1 i. 0 ir.	A. B.
13 p. 0 m. 1 i. 1 ir.	13 p. 2 m. 0 i. 0 ir.	9 p. 7 m. 2 i. 0 ir.	A. G.
24 p. 1 m. 1 i. 1 ir.	49 p. 7 m. 1 i. 0 ir.	47 p. 14 m. 4 i. 0 ir.	Total.

TABLE IX (b).
Temporal Variations. (Absent.)

I.	IV.	VII.	
15	9	9	G. B.
12	11	7	G. G.
17	2	3	A. B.
8	6	1	A. G.
52	28	20	Total.

(1) Increased tendency toward temporal subordination in grouping runs parallel with increase in mental development; the difference between the first and fourth grades, in this respect, is greater than that between the fourth and seventh. (2) There are numerous cases of inversion. These arose through prolongation of the last syllable into the time of the pause. Inversion here, as elsewhere, does not seem to be a function of age; it is even more frequent with the older children. (3) The effect of practice is greater upon the German children; with them there was a marked increase of temporal and intensive differentiation in the fourth and fifth series, and a corresponding increase in the unity of the grouping. In the case of the American children, the rhythm of the third, fourth and fifth series showed scarcely any deviations from that of the first.

Are there closer relationships existing between any two of these objective factors than between the others? When the rhythms are not determined by all three, temporal, intensive

and qualitative, which two appear most frequently together? An answer to this question would throw light upon the subjective nature of these objective factors. The results have been tabulated to show these relations.

TABLE X.

P. and I. present together.			T. and I. present together.			P. and T. present together.			
I.	IV.	VII.	I.	IV.	VII.	I.	IV.	VII.	
9	5	6	0	0	0	2	1	0	G. B.
7	8	2	0	0	2	1	2	2	G. G.
1	0	1	1	5	3	1	2	1	A. B.
1	5	0	2	3	3	0	2	0	A. G.
18	18	9	3	8	8	4	7	3	Total.

P. T. and I. present together.			P. T. and I. absent.			
I.	IV.	VII.	I.	IV.	VII.	
2	9	14	17	9	9	G. B.
3	8	14	12	12	9	G. G.
0	11	9	22	11	9	A. B.
8	13	14	14	9	8	A. G.
13	41	51	65	41	35	Total.

The mediation of the grouping through variation in pitch and intensity alone appears frequently among the Germans; it is less noticeable in the upper grades, as all three factors are there more often present. A *T-I* grouping is more characteristic of the Americans; while a grouping mediated by *P* and *T* seldom characterizes the German or American reading. This would seem to indicate that pitch cannot be a complete substitute for intensity, but rather serves to heighten the effect of an intensity variation. Cf. the discussion of pitch, for the relations between pitch and intensity.

The rhythm certainly gained in richness of content and unity of impression with increase in years.

Pause.—Unfortunately for the results, as to the relation of the pause in the group, the observations on German children are incomplete. The position of the pause was noted only in very striking cases; consequently, a satisfactory basis for comparison with the results obtained from American children is wanting, as absence or presence, regularity or irregularity, was noted here in every reading.

TABLE XI (a).

Position of Pause. Americans.

(Results for boys and girls given together.)

I.	IV.	VII.	
44	44	37	TOTAL NUMBER OF READINGS.
8	4	4	Pause after each syllable.
29	40	33	Pause after every second syllable only.
—	—	1	Pause after third syllable only.
12	1	1	Absent or irregular.

TABLE XI (b).

Position of Pause. Germans.

(Results for boys and girls given together.)

I.	IV.	VII.	
34	38	48	TOTAL NUMBER OF READINGS.
5	1	2	Pause after each syllable.
12	20	15	Pause after every second syllable.
0	1	0	Pause after every third syllable.
?	?	?	Absent or irregular.

There are frequent lapses into a primary rhythm in the trochaic reading of the first grade. With one exception, this primary grouping retained the temporal, intensive or qualitative subordination characteristic of a trochaic grouping.

There are a large number of irregular readings among the American children of the first grade; the boys, particularly, were very unrhythmical.

Results from the Trochaic Readings by Method II. Figures for time and pitch represent the mean values for each series.

TABLE XII.—C. D.

TIME.				Intensity.	Pitch.
Syllable. (a)	(b)	Pause. (a)	(b)		
(1) .789 sec.	.361 sec.	.093 sec.	.435 sec.	a > b (3); a=b (8)	a=b
(2) .743 "	.313 "	.102 "	.597 "	a=b (12)	a=b
(3) .985 "	.312 "	.12 "	.402 "	a > b (4); a=b (6)*	a higher than b.
(4) .87 "	.311 "	.102 "	.545 "	a=b (11)*	a higher than b.
(5) .767 "	.398 "	.062 "	.358 "	a=b (14)	a 318.75 vib. b 318.75 vib.
(6) .802 "	.504 "	.065 "	.311 "	a > b (6); a=b (1)	a 300.93 " b 288.43 "

* The microphone responded poorly.

TABLE XIII.—*H.*

TIME.				Intensity.	Pitch.
Syllable.		Pause.			
(a)	(b)	(a)	(b)		
(1) .419 sec.	.25 sec.	.183 sec.	.416 sec.	a > b (7); a = b (2)	a higher than b
(2) .46 "	.365 "	.142 "	.23 "	a > b (15); a = b (1)	a " " b
(3) .444 "	.448 "	.14 "	.206 "	a > b (13)*	a " " b
(4) .52 "	.438 "	.131 "	.24 "	a > b (15)*	a " " b
(5) .409 "	.414 "	.115 "	.131 "	a > b (14)	a 306 .25 vib. b 257 .69 vib.

* a twice as intensive as b.

Pitch intervals vary between a second and a fourth.

TABLE XIV.—*R. A.*

TIME.				Intensity.	Pitch.
'Syllable.		Pause.			
(a)	(b)	(a)	(b)		
(1) .58 sec.	.445 sec.	.43 sec.	.595 sec.	a=b (10)	a=b
(2) .57 "	.457 "	.42 "	.513 "	a> b (7); a=b (3)	a=b
(3) .504 "	.195 "	.19 "	.984 "	a=b (12)*	a=b
(4) .488 "	.397 "	.193 "	.638 "	a=b (10)*	a=b
(5) .628 "	.575 "	.413 "	.44 "	a> b (3);a=b (7)	a higher than b
(6) .637 "	.56 "	.362 "	.437 "	a> b (3);a=b (5)	a higher than b
(7) .647 "	.347 "	.387 "	.493 "	a=b (10)	a higher than b

* The microphone responded poorly.

Difference in pitch, when present, never exceeded the major second.

Some of the series were taken under favorable conditions, the microphone responding as readily as could be desired; where particular difficulties were experienced, they have been noted.

There was a secondary grouping in the reading of *H.* and *C. D.*, corresponding to the breathing rhythm, which could not be shown in the tabulated results; each of the larger groups contained six to ten smaller groups (or in metrical language 6 to 10 feet). The larger groups were separated by longer pauses of .3 to .7 sec. in duration.

The difference between the lengths of the intervening and the succeeding pause increased from the first grade up; *R. A.* (first grade) gave, with the exception of two series, very slight time-differences in her readings; with *H.*, the differences in duration of the pauses, although greater than with *R. A.*, were not marked; while with *C. D.* they were very marked. The same thing is true of the duration of the syllables, but in a less noticeable degree.

The results for intensity are not entirely satisfactory, for, as

C. D. complained at the time of the third series, in order to give the weak syllable intensity enough to insure a response from the microphone, it was necessary to speak so loudly that the loudest syllable could hardly be made more intense. The correlation between greater frequency and completeness of intensive subordination and increase in age is not borne out in this experiment. The lack of delicacy in the responses of the microphone was, no doubt, a partial cause, although not a sufficient one. The natural reading of *C. D.* never showed great intensive variations.

In the two cases where *R. A.*'s reading showed a noticeable temporal subordination, there was neither an intensive nor a qualitative differentiation present: this was a case of supplementing similar to Meumann's *Stellvertretung*. *R. A.*'s grouping is not of any particular type; it is partly temporal, partly intensive, and for the last series slightly qualitative.

H. tends to a markedly intensive-qualitative rhythm; temporal differences are very slight. In series (3) he approached a spondaic time order. Pitch differences are always present, and greater than for *C. D.* or *R. A.* *C. D.*'s reading is of a temporal type, with few or slight differences in intensity or pitch, but with striking differences in temporal arrangement.

H.'s reading was always more natural, less strained, than that of *C. D.* *C. D.* was, as has been stated, a very painstaking, conscientious child, and labored to give what he thought was desired; while *H.* read as he pleased. It is therefore probable that in the grouping given by *H.* we have a nearer approach to the natural spontaneous rhythm of speech.

The figures for pitch are, like those for time, averages of long series; they do not therefore represent the number of vibrations which were actually given, but show all that they were expected to represent,—the relative intervals between the two syllables. In the readings given by *R. A.*, and in the greater number of those given by *H.* and *C. D.*, it was impossible to read the number of vibrations as shown on the record. By a change in the recording apparatus and an increase of the rate of revolution of the drum, we were enabled, however, to obtain a few records which showed approximately the number of vibrations; it was necessary, even in this case, to use a magnifying glass for reading the records.

It is to be noted that the time-relations could not be expressed by simple numbers.

Total for Five Series of Iambic Readings.

In this case the children were requested to emphasize the second and every alternate syllable.

TABLE XV (a).
Pitch Variations. (Present.)

I.	IV.	VII.	
6 p. 2 m. 10 i. 2 ir.	14 p. 0 m. 1 i. 1 ir.	10 p. 9 m. 3 i. 1 ir.	G. B.
9 p. 1 m. 4 i. 0 ir.	13 p. 4 m. 1 i. 0 ir.	20 p. 1 m. 3 i. 1 ir.	G. G.
7 p. 2 m. 0 i. 2 ir.	13 p. 0 m. 6 i. 0 ir.	17 p. 0 m. 0 i. 0 ir.	A. B.
4 p. 0 m. 0 i. 1 ir.	9 p. 3 m. 2 i. 0 ir.	14 p. 0 m. 0 i. 2 ir.	A. G.
26 p. 5 m. 14 i. 5 ir.	49 p. 7 m. 10 i. 1 ir.	47 p. 10 m. 6 i. 4 ir.	Total.

TABLE XV (b).
Pitch Variations. Absent.

I.	IV.	VII.	
0	3	0	G. B.
2	0	0	G. G.
13	3	2	A. B.
16	7	5	A. G.
31	13	7	Total.

(1) The parallelism between increasing differentiation of the rhythm and increasing age is still noticeable, although there is scarcely any difference between the fourth and the seventh grades in this respect. (2) A qualitatively determined rhythm still appears to be characteristic of the German rather than of the American reading. (3) The cases of inversion are much more frequent than with the trochee; this is particularly true of the Germans, who in such cases reverted to a pure trochaic form. (4) Comparing the trochaic and iambic groupings as to pitch relations, we note that there is exactly the same number of absences in the iambic as in the trochaic readings of both the first and fourth grades; but with the seventh grade, pitch variations are absent but seven times, while with the trochee they are wanting in eleven readings. (5) There are fewer instances of intervals of a fourth in the iambus than in the trochee; the intervals often gradually diminished as the reading proceeded. This fluctuation in pitch was a characteristic feature of the iambic grouping.

(1) Regular intensive variations are less frequent than are qualitative. (2) They occur more rarely than in the trochaic grouping. The greater variety of intensive variations in the iambus is doubtless due to the same cause as the smaller pitch intervals. The result is a weakening and fading-out of the

TABLE XVI (a).
Intensity Variations. (Present.)

I.	IV.	VII.	
6 p. 4 m. 1 i. o ir.	7 p. 5 m. o i. o ir.	16 p. 2 m. o i. o ir.	G. B.
6 p. 5 m. o i. 1 ir.	16 p. 4 m. o i. o ir.	13 p. 2 m. o i. o ir.	G. G.
2 p. o m. o i. o ir.	9 p. 2 m. 1 i. 1 ir.	9 p. 2 m. 2 i. o ir.	A. B.
7 p. 2 m. o i. 4 ir.	7 p. 2 m. 1 i. 2 ir.	12 p. 3 m. o i. o ir.	A. G.
21 p. 11 m. 1 i. 5 ir.	39 p. 13 m. 2 i. 3 ir.	40 p. 9 m. 2 i. o ir.	Total.

TABLE XVI (b).
Intensity Variations. (Absent.)

I.	IV.	VII.	
3	7	5	G. B.
3	3	8	G. G.
20	7	6	A. B.
11	7	5	A. G.
37	24	24	Total.

distinctive marks. *Cf.* later discussion. (3) Correlation of increasing intensive differentiation with increasing age is still to be noted, although not marked.

TABLE XVII (a).
Time Variations. (Present.)

I.	IV.	VII.	
2 p. o m. 1 i. o ir.	9 p. 3 m. o i. o ir.	13 p. 1 m. o i. o ir.	G. B.
2 p. 1 m. 2 i. o ir.	11 p. 4 m. 1 i. o ir.	11 p. 4 m. 4 i. o ir.	G. G.
3 p. o m. 2 i. o ir.	10 p. 1 m. 2 i. o ir.	10 p. 2 m. 1 i. o ir.	A. B.
9 p. o m. 2 i. o ir.	10 p. 1 m. 2 i. o ir.	10 p. 2 m. 1 i. o ir.	A. G.
16 p. 1 m. 7 i. o ir.	40 p. 9 m. 5 i. o ir.	44 p. 9 m. 7 i. o ir.	Total.

TABLE XVII (b).
Time Variations. (Absent.)

I.	IV.	VII.	
15	7	9	G. B.
11	7	6	G. G.
17	8	5	A. B.
9	4	4	A. G.
52	26	24	Total.

(1) Cases of inversion in the temporal relations are far more numerous in the iambus than in the trochee; although subordinations in temporal arrangement are about as frequent. (2) The irregularities found in the intensive, and still more often in the qualitative arrangement disappear here entirely. (3) The parallelism found in all the other instances is still to be noted.

TABLE XVIII.

P. and I. present together.			T. and I. present together.			P. and T. present together.			
I.	IV.	VII.	I.	IV.	VII.	I.	IV.	VII.	
13	5	5	1	3	1	0	2	0	G. B.
7	5	3	1	1	3	0	0	0	G. G.
0	2	3	2	2	3	1	2	3	A. B.
2	3	2	2	4	3	4	1	0	A. G.
22	15	13	6	9	10	5	5	3	Total.

P., T. and I. present.			P., T. and I. absent.		
I.	IV.	VII.	I.	IV.	VII.
1	5	12	18	13	11
4	15	13	11	5	12
0	9	7	22	13	11
3	11	11	19	11	8
8	40	43	70	42	42

A grouping marked only by variations in *P.* and *I.* is still favored by the German children, especially by the first grade boys. *P.* and *T.* variations seldom occur alone; this was noted in the trochaic grouping. *T.* and *I.* are still favored by the Americans rather than by the Germans. *P.*, *T.* and *I.* subordinations within the same group are less frequent than in the trochee; this is especially true of the first grade. An exception to this rule is furnished by the reading of the German girls in the fourth grade; it can be partly accounted for by the fact that the full number of readings was given by a girl of a distinctly iambic-anapæstic type. In general we note here the same tendency to a looser grouping, *i. e.*, one possessing fewer distinctive marks, that was before noted.

Pause.—For the reason before mentioned, the results from the German children are not complete.

A pause often occurs after the first syllable, together with differences in pitch and in intensity. In the primary grouping, each syllable was frequently pronounced with a strong expira-

TABLE XIX (a).
Position of Pause. Americans.
 (Results for boys and girls given together.)

I.	IV.	VII.	
44	44	37	TOTAL NUMBER OF READINGS.
8	4	1	Pause after each syllable.
25	33*	37	Pause after every second syllable.
11	4	0	Pause absent or irregular.

TABLE XIX (b).
Position of Pause. Germans.
 (Results of boys and girls given together.)

I.	IV.	VII.	
34	38	48	TOTAL NUMBER OF READINGS.
5	1	0	After every syllable.
6	9	23	After every second syllable.
?	?	?	Absent or irregular.

*One child gave a double two-grouping by lengthening the pause after the fourth in relation to that after the second syllable.

tory movement. There are more instances of irregularities than in the trochaic rhythm. A reversion to forms 2 and 3 of the involuntary series, *i. e.*, a grouping effectuated by pause alone, occurred eleven times among the American boys of the first grade and six times among the girls of the same grade.

With the first grade, the iambic grouping is loose, *i. e.*, it lacks the unitary character of the trochaic; it is frequently turned into the trochaic form through inversion in time, pitch or intensity, or in all three.

Results from the Iambic Readings by Method II. Figures for time and pitch represent the mean values of each series.

TABLE XX.—C. D.

TIME.				Intensity,	Pitch.
Syllable. (a)	(b)	Pause. (a)	(b)		
(1) .613 sec.	.685 sec.	.13 sec.	.3 sec.	b > a (14); b = a (1)	?
(2) .607 "	.625 "	.121 "	.344 "	b > a (9); b = a (4)	b higher than a
(3) .733 "	.766 "	.123 "	.251 "	b > a (10); b = a (2)	b " " a
(4) .716 "	.688 "	.123 "	.345 "	b > a (11); b = a (1)	b " " a
(5) .803 "	.792* "	.086 "	.166 "	b > a (1); b < a (14)*	a 313.33 vib.
(6) .71 "	.767 "	.076 "	.196 "	b > a (1); b = a (4); b < a (6)	b 362.22 "
					a 282.35 "
					b 297.97 "

*Time and intensity trochaic, voice-fall iambic.

TABLE XXI.—*H*.

TIME.				Intensity.	Pitch.	
Syllable. (a) (b)		Pause. (a) (b)				
(1)	.495 sec.	.439 sec.	.112 sec.	.225 sec.	Record not clear.	b higher than a
(2)	.389 "	.385 "	.116 "	.298 "	b> a (8); b=a (3)	b " " a
(3)	.415 "	.451 "	.147 "	.195 "	b> a (12); b=a (1); b <a (3)	b " " a
(4)	.379 "	.27* "	.223 "	.496 "	b> a (2); b=a (2); b <a (10)	b " " a
(5)	.398 "	.34 "	.148 "	.203 "	b> a (14); b=a (4); b <a (1)	b " " a
(6)	.483 "	.374 "	.151 "	.293 "	b> a (12); b=a (3); b <a (1)	b " " a
(7)	.364 "	.411 "	.116 "	.146 "	b> a (15); b=a (1)	a 298.9 vib. b 371.25 vib.

*He begins after each inspiration with a trochaic grouping, which gradually becomes iambic; fluctuation between trochaic and iambic grouping is characteristic of the whole series.

TABLE XXII.—*R. A*.

TIME.				Intensity.	Pitch.
Syllable. (a) (b)		Pause. (a) (b)			
(1)	.555 sec.	.362 sec.	.437 sec. .59 sec.	b = a (12)	No variations
(2)	.486 "	.486 "	.4 " .432 "	b > a (6); b = a (4); b < a (1)	" "
(3)	.417 "	.293 "	.323 " .866 "	b = a (10)	" "
(4)	.398 "	.38 "	.267 " .745 "	b = a (7); b < a (3)	" "
(5)	.414 "	.442 "	.36 " .431 "	b = a (12)	" "
(6)	.473 "	.437 "	.437 " .466 "	b = a (12)	" "
(7)	.582 "	.537 "	.411 " .35 "	b = a (8); b < a (3)	a higher than b
(8)	.51 "	.568 "	.446 " .473 "	b > a (2); b = a (9); b < a (1)	a higher than b

R. A., as a rule, gave the iambus the temporal arrangement of the trochee; exceptions to this rule were: in series 2, (a) and (b) were of exactly the same duration; and series (5) and (8) showed a slight lengthening of the second syllable in comparison with the first. When intensive subordinations occurred, though these were less frequent than temporal, (a) was more intense than (b), except during part of series (2) and (8), where (b) was slightly more intense than (a). Voice-fall, if noticeable at all, was always trochaic. A tendency to primary grouping, through making the pause following (a) nearly as long as that following (b), was characteristic of *R. A.*'s reading as a whole; this is especially true of series (5), (6), (7) and (8). A peculiarity of series (7) is the presence of a longer pause after (a) than after (b).

With *H*. there is evidence of a conflict between the tendency to give the more natural trochaic grouping and his desire to read as asked. The temporal arrangement is trochaic in series (1), (2), (4), (5) and (6). Intensive subordinations are far more frequent than with *R. A.*; part of every series has an

iambic arrangement of intensity, although no one series has this arrangement only. The voice-fall throughout is that found to be typical of the iambic grouping; the interval is slightly greater than in the trochee. Here, as in the results obtained from the trochaic reading, *H.*'s reading was determined by intensive and qualitative rather than by temporal subordination. His arrangement of pauses [(b) having a greater duration than (a)] results in a more unitary grouping than the arrangement given by *R. A.*

With the exception of series (4) and (5), *C. D.* preserved the characteristic temporal arrangement of the iambus, although the difference between the duration of (a) and (b) was not so great as in the trochaic reading; there, (b) had a duration varying from one-half to one-third that of (a), while here the difference never exceeded a few hundredths of a second. Neither is the relative difference in the duration of the pauses so great as with the trochee; however, the subordination of the intervening pause to the succeeding is greater than in *H.*'s reading, and markedly greater than in *R. A.*'s. While the syllables (a) and (b) are often given the same intensity, the only cases of inversion in intensive arrangement are found in series (5) and (6). The voice-fall throughout was the characteristic iambic. *C. D.*'s reading as a whole was characterized by fewer inversions than *H.*'s and greater unity in the grouping than *R. A.*'s. All three experienced greater difficulty in rendering the iambic; this is in harmony with the result obtained by Method I.

Total for Five Series of Dactylic Readings.


The problem was modified by requiring the emphasis on the first syllable and every third following. Four arrangements of the syllables, as to pitch, (a) (b) (c) (d) were noted. The arrange- ment is not intended to denote absolute relations, but merely to show the direction of variation.

TABLE XXIII.

German.				American.			
I.	IV.	VII.		I.	IV.	VII.	
4	0	0	Order (a)	20	5	4	Order (a)
13	18	25	" (b)	7	30	26	" (b)
9	2	2	" (c)	0	3	4	" (c)
3	10	4	" (d)	0	0	2	" (d)

This tabulation does not account either for the irregular readings or for the cases of inversion, which would have nearly an obverse arrangement. In the reading given by the German

children, it is to be observed that arrangement (a) occurs only in the first grade; (c) occurs more frequently in the first grade; (b), the commonest form, is found in all the grades; (d) occurs more frequently in the higher grades. If we compare the readings of the American with those of the German children, the greater frequency of arrangement (a) in the reading of the former is noticeable; (c) occurs more frequently in the readings of the fourth and seventh American grades than with the Germans; while (b) seems in the great majority of cases to be the closest grouping obtained by the Americans, (d) occurring only twice, and then in the seventh grade. This shows, even more strikingly than the results obtained in the trochaic and iambic readings, the greater tendency of the German children toward the introduction of a qualitative determinant into the simplest grouping.

It might be asked whether the ascending order of rhythmical grouping, as to unity and complexity of the rhythm, is in the order (a), (b), (c) and (d). Does (d) give a more unitary impression than (b)? For us, (d) is a much more satisfactory arrangement. Cf. the discussion of pitch below.

TABLE XXIV (a).
Pitch Variations. (Present.)

I.	IV.	VII.	
13 p. 1 m. 4 i. o ir.	14 p. 3 m. o i. 1 ir.	14 p. 7 m. o i. 1 ir.	G. B.
9 p. 1 m. o i. 3 ir.	15 p. 7 m. o i. o ir.	21 p. 2 m. o i. 1 ir.	G. G.
o p. 1 m. o i. 1 ir.	13 p. 2 m. 2 i. o ir.	12 p. 2 m. 1 i. o ir.	A. B.
6 p. 1 m. 1 i. o ir.	18 p. 1 m. o i. o ir.	12 p. 3 m. 2 i. o ir.	A. G.
28 p. 4 m. 5 i. 4 ir.	60 p. 13 m. 2 i. 1 ir.	59 p. 14 m. 3 i. 2 ir.	Total.

TABLE XXIV (b).
Pitch Variations. (Absent.)

I.	IV.	VII.	
1	1	0	G. B.
3	0	1	G. G.
18	5	3	A. B.
16	3	2	A. G.
38	9	6	Total.

The American boys of the first grade, and three of the girls, failed in every attempt to produce the dactyl and the anapæst, falling into an unaccented two-grouping, a weakly accented

trochaic or an irregular primary rhythm. The same facts come out in this Table as were observed in Tables VII and XV.

TABLE XXV (a).
Intensity Variations. (Present.)

I.	IV.	VII.	
9 p. 3 m. o i. o ir.	13 p. 2 m. o i. i ir.	12 p. 5 m. o i. o ir.	G. B.
5 p. 2 m. o i. i ir.	14 p. 4 m. o i. o ir.	14 p. 5 m. o i. o ir.	G. G.
2 p. o m. o i. 4 ir.	11 p. 1 m. 3 i. o ir.	10 p. 4 m. o i. o ir.	A. B.
10 p. 5 m. o i. o ir.	14 p. 4 m. o i. o ir.	13 p. 1 m. 3 i. o ir.	A. G.
26 p. 10 m. o i. 5 ir.	52 p. 11 m. 3 i. i ir.	49 p. 15 m. 3 i. o ir.	Total.

TABLE XXV (b).
Intensity Variations. (Absent.)

I.	IV.	VII.	
7	3	5	G. B.
8	4	6	G. G.
15	7	4	A. B.
9	4	2	A. G.
39	18	17	Total.

(1) This Table shows the same relations between age of individual and completeness of grouping that we have found in the others. (2) Inversions are less frequent than in the case of the iambus. (3) The intensity relations are more varied than in the two-groupings. As a rule, the second was less intense than the third, which was in turn less intense than the first (—' — —'); having, however, no accurate means of recording these differences, we cannot give the different arrangements as accurately as in the case of pitch. Cf. results from Method II; also discussion of the arrangement found by Bolton.

TABLE XXVI (a).
Time Variations. (Present.)

I.	IV.	VII.	
10 p. o m. o i. o ir.	11 p. 5 m. o i. o ir.	12 p. 6 m. o i. o ir.	G. B.
3 p. o m. o i. o ir.	7 p. 1 m. o i. o ir.	15 p. 8 m. o i. o ir.	G. G.
2 p. o m. i i. 2 ir.	12 p. 4 m. 3 i. o ir.	11 p. 6 m. o i. o ir.	A. B.
10 p. 1 m. o i. o ir.	12 p. 7 m. i i. o ir.	14 p. 1 m. 3 i. o ir.	A. G.
25 p. 1 m. i i. 2 ir.	42 p. 17 m. 4 i. o ir.	52 p. 21 m. 3 i. o ir.	Total.

TABLE XXVI (b).
Time Variations. (Absent.)

I.	IV.	VII.	
9	3	4	G. B.
13	4	2	G. G.
16	3	3	A. B.
13	2	1	A. G.
51	12	10	Total.

(1) There are fewer irregularities in the temporal than in the intensive and qualitative arrangement. (2) The parallelism between increased age and increased frequency of differentiating marks, found in all the other Tables, does not fail here.

There were a number of temporal arrangements observed; at times the first seemed as long as the second and third together; then the first appeared only a trifle longer than the second, and the second longer than the third; and then again the first had the greatest duration, the third came next in order of duration, while the second had the least. These results were objectively substantiated by the results of Method II. *Cf.*, for further discussion, temporal factor in rhythm.

TABLE XXVII.

P. and I. present together.			T. and I. present together.			P. and T. present together.			
I.	IV.	VII.	I.	IV.	VII.	I.	IV.	VII.	
4	1	3	0	1	0	1	0	3	G. B.
6	2	1	0	3	1	2	2	0	G. G.
0	1	1	1	2	1	0	0	0	A. B.
2	0	0	3	1	1	0	0	1	A. G.
12	4	5	4	7	3	3	2	4	Total.

P. T. and I. present.			P. T. and I. absent.		
I.	IV.	VII.	I.	IV.	VII.
8	14	14	11	4	9
0	16	16	15	4	9
1	11	10	21	11	8
5	16	15	17	6	4
14	57	55	64	25	30

It is interesting to note how much more complete the dactylic

grouping is than the trochaic or the iambic. P., T. and I variations occur together:

	I.	IV.	VII GRADES.
In the trochaic readings,	13	41	51 times.
In the iambic readings,	8	40	43 times.
But in the dactylic readings,	14	57	55 times.

The greater number of possible arrangements of these three factors gives a variety and richness of content impossible in the two-groupings.

TABLE XXVIII (a).

Position of Pause. Americans.

(Results for boys and girls given together.)

I.	IV.	VII.	
44	44	37	TOTAL NUMBER OF READINGS.
8	1	0	After every syllable.
6	2	0	After every second syllable.
12	20	20	After every third.
6	18	16	After first and third.
12	3	1	Absent or irregular.

TABLE XXVIII (b).

Position of Pause. Germans.

(Results for boys and girls given together.)

I.	IV.	VII.	
44	44	37	TOTAL NUMBER OF READINGS.
8	1	1	After every syllable.
1	1	0	After every second syllable.
5	11	11	After every third.
8	15	24	After every first and third.
?	?	?	Absent or irregular.

(1) There was frequently a minor pause after the first with a longer pause after the third; this was especially true of the readings of the children of the upper grades. (2) We still find instances, notably in the first grade, in which a pause occurred after each syllable; generally then the primary rhythm was produced, though there were instances in which accented syllables were so separated. The appearance of the two-grouping also marked the failure of the younger children to bring the three syllables into an unity.

Results from the dactylic readings by Method II.
TABLE XXIX.—C. D.




TIME.			INTENSITY.		PITCH.	
Syllable.			Pause.			
(a)	(b)	(c)	(a)	b	(c)	
(1) .665 sec. .607 sec. .437 sec.			.171 sec. .164 sec. .339 sec.			?
(2) .686 " .601 " .425 "			.145 " .175 " .303 "			
(3) 1.016 " .511 " .363 "			.163 " .216 " .269 "			
(4) .894 " .525 " .394 "			.247 " .162 " .283 "			
(5) .677 " .632 " .452 "			.311 " .267 " .276 "			(a) 311 vib. (b) 267.5 vib. (c) 276.8 vib.
(6) .679 " .636 " .528 "			.069 " .082 " .236 "			(a) 336 vib. (b) 266 vib. (c) 325 vib.
			a> b and c (4)	a=b=c (4)		
			a> b and c (15)			
			a> b and c (5); a> c> b (1)			
			a> b> c (1); a> b and c (5); a> c> b (2)			
			a> b> c (2); a> b and c (5); a> c> b (2)			
			a> b> c (2); a> b and c (5); a> c> b (2)			
			a> b and c (5); a> c> b (2)			
			a> b and c (15)			
			a> b and c (4)			

TABLE XXX.—H.







TIME.			INTENSITY.		PITCH.	
Syllable.			Pause.			
(a)	(b)	(c)	(a)	(b)	(c)	
(1) .365 sec. .391 sec. .309 sec.			.174 sec. .176 sec. .287 sec.			a> b and c (8); a=b=c (3); [c> a> b (1)
(2) .381 " .429 " .256 "			.152 " .181 " .383 "			a=b=c (7)
(3) .348 " .338 " .293 "			.103 " .113 " .193 "			a> b and c (8); a> c> b (5)
						(a) 392. 2 vib. (b) 294.6 vib. (c) 295.7 vib.
						
						
						

TABLE XXXI.—R. A.

TIME.			INTENSITY.		PITCH.	
Syllable.			Pause.			
(a)	(b)	(c)	(a)	(b)	(c)	
(1) .409 sec. .3 sec. .328 sec.			.435 sec. .495 sec. .528 sec			No pitch difference.
(2) .473 " .321 " .358 "			.43 " .506 " .537 "			" "
(3) .434 " .305 " .198 "			.406 " .516 " .59 "			" "
(4) .51 " .428 " .403 "			.45 " .404 " .604 "			a=b=c (6)
(5) .646 " .577 " .555 "			.46 " .47 " .633 "			a> b> c (1); a> b and c (2); a=c=b (1); a and b> c (2)
(6) .413 " .4 " .354 "			.381 " .412 " .451 "			a=b=c (8)
(7) .439 " .367 " .315 "			.333 " .406 " .46 "			a=b=c (8)
						
						
						

R. A. In general the time order was ———', ———', ———'; but in series (1) and (2) the order is ———', ———', ———'; this order was often present in the breathing rhythm, when it was not apparent in the spoken rhythm synchronously given. It was also frequently found in the freer readings of Method I. The difference in duration of the pauses was very slight; again, as in the iambic readings as well as in her breathing rhythm, we see evidence of a very loose grouping, at times only very slightly differentiated from the primary. As a rule the shortest pause occurred after the long syllable, and the longest after the last. This arrangement of pauses was not found in the readings without the microphone.

In three series there was no regular intensity variation. The arrangement ———' ——— ——— occurred seven times; ———', ———' four times. This arrangement was scattered through the different series. Order ———', ——— ——— was found nine times. Where pitch differences were present, only the arrangements noted as (b) and (c) were found.

H. The fewer series shown for *H.* are due to difficulties arising from the adjustment of the microphone; several series were illegible, and therefore could not be utilized. The experiments were made during the height of the winter season, and sudden changes of temperature in the experimenting room were unfavorable to a perfect adjustment of the microphone. In series (1) and (2) we have an unusual arrangement as to time; ——— ——— ———, *i. e.*, the second syllable longer than the first. The order of series (3) ——— ——— ——— was frequent in *R. A.*'s reading; it is the only order which Bolton and McKay and Hurst regard as characteristic of dactylic grouping. *Cf.* later discussion. The order given in series (1) and (2) can scarcely be regarded as natural; it can easily be accounted for by the resistance of the microphone. This was greater for the initial syllable, and led to an overestimation of the first syllable and an underestimation of the second; and a temporal inversion was the result. Intensive variations were not as frequent as in the trochaic and iambic readings. The arrangements were ———', ——— ——— noted 17 times, ———', ———' ——— noted 3 times; ———', ——— ———' noted 5 times. There were 10 instances of unaccented readings and one case of inversion. *H.* always had a marked pitch difference, and in the customary direction.

C. D. He never regulated his breathing well; one group followed another with scarcely a pause between, until he was finally forced to stop for breath. The consequence was that the last syllable of the secondary group was cut short; this fact is brought out clearly in the breathing curve. A curious inversion in the duration of the pauses occurred in series (5);

otherwise the duration of the pauses followed the inverse order of the syllables. Variations in intensity were nearly always present. The arrangements were the same as those found in *H.*'s reading; —'' —'' —'' was noted seven times, —'' —'' —'' eight times, and —'' —'' —'' 39 times. There was one case of inversion in pitch (*cf.* last series); otherwise the only two forms noted were those found to be characteristic of the older children in the free readings.

Total for Five Series of Anapæstic Readings.

In a general way the anapæstic grouping was the obverse of the dactylic, in its temporal, intensive and qualitative arrangements.

TABLE XXXII.

German.				American.			
I.	IV.	VII.		I.	IV.	VII.	
0	0	0	Order (a)	0	0	0	Order (a)
12	19	32	" (b)	8	27	26	" (b)
2	2	6	" (c)	0	3	1	" (c)
3	19	9	" (d)	0	1	1	" (d)

Arrangement (d) occurred more frequently in the reading of the German children; this is in harmony with all the results so far obtained. Arrangement (c) appeared very seldom even among the younger children, less frequently even than in the dactylic grouping. Arrangement (b) is most frequent with all the grades.

TABLE XXXIII (a).
Pitch Variations. (Present.)

I.		IV.		VII.		
5 p. 3 m.	7 i. 1 ir.	12 p. 2 m. 1 i. 0 ir.	11 p. 9 m. 0 i. 1 ir.			G. B.
7 p. 0 m.	3 i. 2 ir.	15 p. 7 m. 1 i. 0 ir.	12 p. 8 m. 2 i. 0 ir.			G. G.
1 p. 0 m.	3 i. 0 ir.	11 p. 0 m. 4 i. 0 ir.	12 p. 1 m. 3 i. 0 ir.			A. B.
3 p. 1 m.	3 i. 1 ir.	14 p. 2 m. 2 i. 1 ir.	13 p. 1 m. 3 i. 0 ir.			A. G.
16 p. 4 m.	16 i. 4 ir.	52 p. 11 m. 8 i. 1 ir.	48 p. 18 m. 8 i. 1 ir.			Total.

TABLE XXXIII (b).
Pitch Variations. (Absent.)

I.		IV.		VII.		
3		4		1		G. B.
4		0		2		G. G.
17		6		2		A. B.
13		3		3		A. G.
37		13		8		Total.

(1) There were a greater number of large intervals recorded in the German than in the American readings. (2) There were more cases of inversion than in the rendering of dactyls. (3) Pitch entered less frequently as a determinant of grouping than in the dactyl.

TABLE XXXIV (a).

Intensity Variations. (Present.)

I.	IV.	VII.	
6 p. 7 m. oi. oir.	9 p. 4 m. oi. oir.	11 p. 9 m. oi. i ir.	G. B.
5 p. 4 m. i i. i ir.	13 p. 2 m. oi. oir.	4 p. 6 m. oi. oir.	G. G.
0 p. 0 m. i i. 2 ir.	7 p. 2 m. 5 i. oir.	14 p. 1 m. oi. oir.	A. B.
9 p. 3 m. oi. i ir.	9 p. 2 m. 2 i. 3 ir.	14 p. 0 m. i i. oir.	A. G.
20 p. 14 m. 2 i. 5 ir.	38 p. 10 m. 7 i. 3 ir.	43 p. 16 m. i i. i ir.	Total.

TABLE XXXIV (b).

Intensity Variations. (Absent.)

I.	IV.	VII.	
5	6	1	G. B.
5	7	15	G. G.
17	5	3	A. B.
13	6	4	A. G.
40	24	23	Total.

The number of inversions in intensity was less than in pitch; but intensive variations were frequently absent.

TABLE XXXV (a).

Time Variations. (Present.)

I.	IV.	VII.	
1 p. 1 m. oi. oir.	8 p. 2 m. oi. i ir.	9 p. 3 m. oi. oir.	G. B.
2 p. 0 m. i i. oir.	13 p. 3 m. i i. oir.	12 p. 8 m. 2 i. i ir.	G. G.
1 p. 0 m. 3 i. oir.	9 p. 3 m. 3 i. oir.	14 p. 1 m. oi. oir.	A. B.
2 p. 3 m. oi. i ir.	13 p. 3 m. i i. 3 ir.	12 p. 0 m. 2 i. oir.	A. G.
6 p. 4 m. 4 i. i ir.	43 p. 11 m. 5 i. 4 ir.	47 p. 12 m. 4 i. i ir.	Total.

TABLE XXXV (b).

Time Variations. (Absent.)

I.	IV.	VII.	
17	8	10	G. B.
13	6	5	G. G.
17	6	3	A. B.
17	2	5	A. G.
64	22	23	Total.

Time played scarcely any part in the anapæstic grouping of the first grade. There were more inversions in time than in intensity.

TABLE XXXVI.

P. and I. present together.			T. and I. present together.			P. and T. present together.			
I.	IV.	VII.	I.	IV.	VII.	I.	IV.	VII.	
11	5	5	0	2	0	0	2	0	G. B.
7	4	1	2	0	0	0	0	2	G. G.
0	0	3	0	3	2	2	2	0	A. B.
1	0	3	0	2	3	1	0	2	A. G.
19	9	12	2	7	5	3	4	4	Total.

P., T. and I. present.			P., T. and I. absent.			
I.	IV.	VII.	I.	IV.	VII.	
1	5	9	18	13	14	G. B.
1	11	9	14	9	16	G. G.
0	7	8	22	15	10	A. B.
4	14	9	18	8	10	A. G.
6	37	35	72	45	50	Total.

P., T. and I differences occurred less frequently than in any of the other rhythms. There was the same fading or weakening of the distinctive characteristics, and consequent lack of unity, that were noted in the iambic grouping.

TABLE XXXVII (a).
Position of pause. Americans.
 (Results for boys and girls given together.)

I.	IV.	VII.	
44	44	37	TOTAL NUMBER OF READINGS.
11	1	2	At the end of each syllable.
8	1	0	After every second.
9	18	20	After every third.
2	16	12	After second and third.
12	3	2	Absent or irregular.

TABLE XXXVII (b).
Grouping by means of pause alone.

First Grade.		
Germans.	Americans.	
I	7	Pause after every syllable.
I	2	Pause after every second.
I	3	Pause after every third.

TABLE XXXVII. (c).
Position of Pause. Germans.
 (Results for boys and girls given together.)

I.	IV.	VII.	
44	44	37	TOTAL NUMBER OF READINGS.
8	2	5	After each syllable.
1	1	0	After every second.
12	13	14	After every third.
5	11	9	After second and third.
?	?	?	Absent or irregular.

This Table emphasizes again the tendency of the younger children to fall into either a primary or two grouping, when attempting to give the three grouping. The large number of cases in which the only differentiation among the syllables was that effected by the pause, also the great number of irregular cases, proved the anapæst to be the most difficult arrangement among those attempted.

Results from the Anapæstic Readings by Method II.

While *C. D.* preserved with but few exceptions the customary order, the longest and loudest coming last in the group, the differences (temporal and intensive) are not so marked as

in the reading of the dactyl. Series (4) has a partly inverted time order (the long syllable taking second instead of third place in the group). The first three series have the order — — — — —; only the last series has the order — — — — —, which Bolton regards as typical. There were eight instances of inversion in the arrangements of the intensities; five instances of an entire absence of intensive subordination. The arrangement most frequently given was — — — — —, which occurred thirty times; arrangement — — — — —, which occurred eight times; and — — — — —, eight times. There were no inversions in pitch.

H.'s rhythm was from the first determined by the intensive and qualitative factors. Here we notice that the characteristic intensive arrangement of the anapæst is preserved: the order — — — — — was most frequent, occurring forty-six times. There are only two cases of partial inversion, in which the first syllable received the same accent as the third. *H.* varied less than *C. D.* from the normal intensive arrangement; but in the temporal arrangements, only the third series can be said to have the characteristic anapæstic order. The order — — — — — occurred in three series, and order — — — — — in two series; both of these are dactylic arrangements. The time differences were too slight to affect the general character of the rhythm. These cases of conflict are interesting, as showing how completely a rhythm may be governed by one or two factors. Such a rhythm, however, lacks the unity and completeness that belong to a grouping where all the factors reinforce one another.

In the reading of *R. A.*, the pauses and syllables had nearly the same duration. Series (5) and (6) present almost perfect cases of the rhythm designated in the involuntary grouping as case 4, *i. e.*, a succession of three syllables equal in intensity, in duration and in pitch, separated by equal intervals, but distinguished as a group from the syllables following by the longer interval after the third syllable. This is but one remove from a primary rhythm. The lack of unity in the grouping, the preservation of the primary rhythm within the complex, is clearly shown in *R. A.*'s breathing curve: each syllable corresponded to an expiration, each pause to an inspiration. The inspiration corresponding to the pause after every third syllable was longer than the inspirations corresponding to the first and second. There were very few instances in which one syllable was subordinated to another in intensity; but in those cases the characteristic anapæstic arrangement was inverted, in every instance but one (the arrangements were either — — — — —, which occurred seven times, or — — — — —, which occurred four times). The single series in which a variation of pitch was

TABLE XXXVIII.—C. D.




TIME.			INTENSITY.		PITCH.	
Syllable.			Pause.			
(a)	(b)	(c)	(a)	(b)	(c)	
(1) .33 sec. .283 sec. .443 sec.			.096 sec. .107 sec. .346 sec.			?
(2) .366 " .354 " .436 "			.079 " .075 " .33 "			
(3) .535 " .516 " .7 "			.123 " .119 " .473 "			
(4) .566 " .58 " .553 "			.114 " .1 " .515 "			
(5) .622 " .65 " .773 "			.064 " .068 " .31 "			(a) 304.16 vib.; (b) 300 vib.; (c) 362.6 vib.
			c> b and a (7); a=b=c (2); a> c and b (5)		b> c> a (3) (b-c a (3))	
			c> a> b (4);			
			c> b> a (3); c> b and a (8); c> a> b (1)			
			c> b> a (3); c> b and a (10); c> a> b (3); a=b=c (1)			
			c> b and a (5);		c=b=a (1)	

TABLE XXXIX.—H.


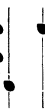


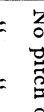







TIME.			INTENSITY.		PITCH.	
Syllable.			Pause.			
(a)	(b)	(c)	(a)	(b)	(c)	
(1) .348 sec. .325 sec. .275 sec. .132 sec. .128 sec. .246 sec.						Not clear.
(2) .363 " .332 " .316 "			.111 " .105 " .183 "			c> b and a (9)
(3) .36 " .364 " .396 "			.152 " .114 " .167 "			c> b and a (5); c> a> b (1); a> and c> b (2)
(4) .404 " .377 " .322 "			.125 " .122 " .213 "			c> b> a(3); c> b and a (9)
(5) .45 " .343 " .359 "			.118 " .123 " .23 "			c> b and a (10)
(6) .343 " .321 " .331 "			.089 " .103 " .143 "			c> b and a (13)
						
						
						
						
					(a) 298 vib.; (b) 318.3 vib.; (c) 357.7 vib.	

TABLE XL.—R. A.

TIME.			INTENSITY.		PITCH.	
Syllable.			Pause.			
(a)	(b)	(c)	(a)	(b)	(b)	
(1) .307 sec. .288 sec. .446 sec. .321 sec. .414 sec. .576 sec.						Not clear.
(2) .283 " .253 " .536 "			.294 " .33 " .489 "			c> b and a (1); c=b=a (6)
(3) .368 " .346 " .432 "			.318 " .328 " .642 "			c=b=a (4); a> b and c (3)
(4) .454 " .446 " .517 "			.332 " .346 " .596 "			Not clear.
(5) .489 " .491 " .491 "			.36 " .346 " .659 "			c=b=c (6); a> b and c (1)
(6) .55 " .57 " .58 "			.415 " .41 " .795 "			c=b=a (4); a> b and c (1)
(7) .616 " .633 " .65 "			.4 " .404 " .529 "			a and b> c (4); a> b and c (2)
					No pitch difference.	
						
						
						
						
						
						
						

observed gave the curious arrangement . Cf. section on Pitch.

The frequent inversion in the reading of all three, the tendency of *R. A.* to pass over to an entirely unmodified or primary rhythm, and the conflicts between (or absence of) differentiating marks in the readings of *H.* and *C. D.*, point to an inherent difficulty in the anapæstic arrangement.

§ 3. SUMMARY.

Two main problems now present themselves. (1) We must enquire into the arrangement of the different rhythmical forms in order of psychological complexity, using the facts brought out in the experiment as a basis for classification and finding, if we can, an adequate psychological explanation for this order. (2) We must collate the data with reference to the objective factors which determine the grouping, and consider their meaning for consciousness.

1. Does the order of increasing difficulty run parallel with that of increasing rhythmical perfection,—rhythmical perfection connoting unitariness of impression for the hearing subject? The predominance of the primary grouping in the free reading of the younger children would indicate a separateness of each syllable or impression in the early consciousness. There are several forms in which a tendency towards a primary rhythm can be discovered in the restrained readings of the same children. It appears in the form of equal pauses, regularly recurring after each syllable,—although these syllables differ regularly among themselves, as to duration, intensity, or pitch; again, in a rhythm of the same character as the former, but lacking the *regular* recurrence of differences,—one syllable being raised above the other at *irregular* intervals; and, finally, in the primary rhythm in which the syllables do not differ perceptibly as to duration, intensity or pitch. These appear to be retrogressive stages which the complex forms undergo, resulting in a gradual loss of their unitary character through the fading out of their distinctive marks; till at last the primary form, the simple, disconnected, although regular succession of one sensation after another is reached. The result seems to be due to a gradual blunting of the sensible discrimination, a blunting which at times is objectively conditioned by the slow rate of succession. A comparison of two syllables, relatively easy when the syllables succeeded each other at such a rate that both fell within the limits of immediate time perception, would be more difficult at a slower rate of succession. Why, then, does this slow rate of succession appear? It follows both from the inability to attend to more than one syllable at a time, *i. e.*, from an extreme narrowness of the range of attention;

and from the slowness with which the attention of the young child functionates, *i. e.*, the longer time necessary to bring any impression into the focus of attention. This retardation doubtless arises through lack of inhibitory control. These facts are shown more clearly in the Tables for the time of a whole series. [Tables XLII (a) and (b).]

Under experimental conditions, the strained attention of adults has been found to cover forty impressions succeeding one another at a rate of from .2 to .3 sec.; but these results, representing as they do the maximal value for trained adults, cannot be approximated in the case of children. Moreover, in the figures given by Wundt¹ the range does not exceed five *units* (each unit containing eight beats) or eight units (each unit containing two beats). An *unit* made up of several impressions is nearly as readily perceived as the simple uncompounded unit; this is of course dependent upon the completeness of unity. Bolton's Subject 9 found that he could not hold more than eight or nine clicks together. Apparently, the range of attention for adults does not exceed eight separate units; with the young child one or at best two *separate* impressions or units seem to be the limit.

The errors arising from the reading of the different restrained forms by Method I, made as they were by so many individuals, have considerable weight in settling the question of the psychological priority of the two over the three grouping. For that reason they have been brought together in tabular form. They are errors in the sense that they are deviations from the normal manner of reading and are due to inversions of one or all of the objective determinants of rhythm, or to general irregularities.

TABLE XLI.
First Grade.

Germans. 35 Readings.		Americans. 46 Readings.	
Trochee,	1 failure.		17 failures.
Iambus,	12 "		22 "
Dactyl,	4 "		24 "
Anapæst,	15 "		33 "

Fourth Grade.

Germans. 41 Readings.		Americans. 43 Readings.	
Trochee,	4 failures.		0 failures.
Iambus,	4 "		15 "
Dactyl,	1 "		4 "
Anapæst,	3 "		12 "

¹ Outlines, Eng. Translation, pp. 214 ff.

Seventh Grade.

Germans. 49 Readings.			Americans. 39 Readings.		
Trochee,	1	failure.	3	failures.	
Iambus,	7	"	6	"	
Dactyl,	2	"	5	"	
Anapæst,	2	"	7	"	

The American boys of the first grade and three of the girls failed in every attempt to produce the dactyl and anapæst. The preference for (and priority of) the two over the three group has been brought out in nearly all of the investigations that have touched upon the question. Miss Smith¹ reports an apparent exception, in which the subject always chose a three-grouping; but it is to be remembered that not only was the subject an adult, who had doubtless made some strong association with the three-grouping, but the purpose of the experiment was the investigation of the effects of the different rhythms upon the memorizing of nonsense syllables. It can be readily understood that the three-grouping, because it broke the total number of impressions into fewer unities, might be more advantageous for memorizing than a two-grouping; this instance cannot therefore be regarded as an exception to the rule that the two-group is psychologically simpler than the three-group. Kuelpe² accounts for the greater ease with which even numbers of impressions are compared than odd by the natural tendency to a two-grouping, although he does not explain this tendency. Bolton's³ subjects had the prevailing tendency to group by twos or fours (which latter is merely a doubling of the two-grouping). In our later experiments with adults on the influence of pitch variations, whenever there was no objective difference between the sounds and subjective grouping took place, the grouping was always by twos or multiples of two. The three-grouping, which Bolton was able to suggest to a few subjects did not once occur with ours, although series of equal sounds were alternated in every experiment with series that were objectively grouped in threes. This suggestion should have been strong enough to have brought about a three-grouping, if mere suggestion was sufficient. Lanier⁴ says: "I think no subject in the history of æsthetics is so curious as the overpowering passion of the English ear for a three rhythm [the two-group] as opposed to the four rhythm" [the three-group]. From our father Caedmon through all the wonderful list down

¹ *Op. cit.*, p. 217.

² *Grundriss der Psychologie*, 1893, p. 409.

³ *Op. cit.*, p. 216.

⁴ *Op. cit.*, p. 41.

to the present day, every long poem and nearly every important short poem in the English language has been written in some form of the three rhythm'' [the two-group].¹

There can be no question but that the two-group is psychologically prior to the three-group. Why should this be the case? Numerous answers are given. Some explain that the two-group falls within the bounds of the natural period of attention. But the three-group has a shorter duration than the two, and would therefore more certainly fall within the required bounds. An explanation in harmony with Buecher's theory must seek to derive the fact of a psychological simplicity of the two-rhythm from its more frequent use in the work of primitive man. Others explain this preference for the two-rhythm as due to its accordance with the bodily rhythms, the expiration and inspiration of respiration, the diastole and systole of the heart, and the swing of the right and left leg in walking.

There is no one principle which satisfactorily explains the preference for the two-rhythm; but there are both psychological and physiological grounds for this preference. That we can think (and use in practical life) a large variety of combinations; while we are, as a matter of fact, restricted to some form of two or three grouping, or their multiples, in rhythmical combinations; is due, we may suppose, to the relativity of our sensible discrimination for intensities. At most we can directly compare but three, and two intensities are compared with greater ease and exactness. This, then, gives us one reason for the preference of the two-rhythm. Moreover, a two-grouping is reinforced by all of the bodily rhythms which fall into unison with any two-rhythm. Thus what is psychologically most simple is also most in harmony with the physiological mechanism.

Is one form of the two-rhythm psychologically more simple than another? Does the accent fall on the last syllable as readily as on the first? The experimental results would indicate, especially in the case of the younger children, that the accent falls most naturally on the first syllable: cf. the great number of cases in which, when the iambic reading was required, the trochaic was given. Other results, beside the proportion of failures in the trochaic and iambic readings, point to the earlier perfection of the trochaic; temporal subordination was not as marked in the case of the iambus as in that of the trochee. There were also a greater number of temporal inversions. The first grade, in their attempt to render the iambus,

¹ Lanier used a peculiar notation based upon the musical: the trochee and iambus have according to this notation three time units, the long (equal to two short) *plus* a short.

reverted very frequently to a grouping characterized only by the pause (either in the form of the primary rhythm or of the spondee). The pitch intervals for the iambus were smaller than for the trochee, and intensity differentiations were also less frequent. Both often decreased in the course of the reading; this no doubt was the result of the gradual withdrawal of the attention from its unnatural position on the second syllable, and in the cases of complete inversion to focusing of the attention on the first syllable of the group. Wundt¹ regards the iambus and trochee as equally simple psychologically; but in the face of experimental facts to the contrary his view can hardly be maintained. Bolton² found that the first sound in the two grouping was accented. The second could be accented by suggestion, but no subjects would agree that it was the natural accent. The experiments show, however, that the great difference between the ease and correctness with which the trochee and iambus are rendered decreases with increasing years, until a few children of the fourth and seventh grades appeared to prefer this grouping. Meumann,³ although he agrees with Wundt as to the simplicity of the iambus, gives us a partial explanation for the trochaic being the more natural grouping. "Central adaptation is more rapid when the first introduction of a rhythmical motive is powerful." Thus the strengthening of the first part of the foot gives any grouping a greater efficacy for reproduction. Ettlinger,⁴ who regards accent as due to the influence of a backward moving force in its inhibition of the forward, finds the trochaic the most natural grouping because the influence of the inhibitory force is strongest immediately after the pause. When Ettlinger's theory is put in terms of attention, the explanation of the natural preference of the trochee is that the first sound following the pause receives, by virtue of contrast with silence, greater attention than the second sound. Thus, even when not objectively accented, it receives a subjective stress as a result of the clearness with which it is focused by the attention.

Riemann⁵ derived the three-group from what he considered the most perfect form of the two-group,—one in which the long was equal to two short. These three equal time units are the basis for the three-grouping. But this is not necessarily the most perfect form of the two-group. On the contrary, the proportion of two to one does not seem to be natural (*cf.* Tables).

¹ Grundzüge, II, p. 86.

² *Op. cit.*, p. 222.

³ *Op. cit.*, p. 299.

⁴ Zur Grundlegung einer Ästhetik des Rhythmus, Zeitschrift, XXII, p. 187.

⁵ Musik-Lexicon, Article *Metrik* (quoted by Meumann).

The time relations as shown by the experiment were not so simple as Riemann's theory would lead us to expect. And it is not necessary to derive the three group from the two; it is more probably an original form, as original as the other.

The experimental results point conclusively to the priority of the dactylic form. The difference in number of errors in the readings by the younger children of the dactyl and anapæst was marked. The anapæst was far more frequently inverted and given as a dactyl, than the dactyl as anapæst. Bolton's subjects heard the first sound in the three-grouping as strongly accented. Occasionally, a subject found it easier to accent the second more than the first, but this did not seem to be the natural way. The reason given above for the preference of the trochee over the iambus would hold for the preference of the dactyl over the anapæst.

The process of inversion was best illustrated in anapæstic grouping; it was also much more frequent here. A peculiar arrangement of intensities which Ettlinger¹ cites in an altogether different reference can be best explained as a stage in the process of inversion. He affirms with Riemann that the greater intensity comes at the beginning and not at the end of the long syllable. Thus a grouping $\smile \quad \underline{\underline{\quad}} \quad \text{and} \quad \smile \quad \smile \quad \underline{\underline{\quad}}$ in the form

could arise from a strong tendency to give the first sound the greater intensity. These forms, in which temporal and intensive relations are in conflict, are not stable or regular forms, as Ettlinger seems to regard them. They are undoubtedly first stages in the process of inversion, which, if the rhythm were continued long enough, would finally give the more natural arrangement of the dactyl, in which the greatest intensity and duration are given to the same sound. Such forms as these frequently occurred in the rendering of the iambus and anapæst by the children, and were always then considered as cases of partial inversion. This also agrees with our observation that pitch and intensity are less stable than time; when inversion is not complete, pitch and intensity are the first to become inverted,—the accent then passing over to the first syllable,—while the temporal arrangement, being more stable, remains as at first; although it, as a rule, also shifted, if the rhythm were continued long enough, until the longest and strongest were no longer in opposition. Another and more common form of inversion, in which the temporal and intensive arrangement shifted at the same time, was apparently effected by a gradual change in the position of the pause; at no time in the process was there a conflict between the

¹ *Op. cit.*, p. 183.

intensive and temporal order. Eberhardt¹ has reported a similar occurrence: with the form $\dot{\text{P}} \dot{\text{P}} \dot{\text{P}} | \dot{\text{P}} \dot{\text{P}} \dot{\text{P}} |$ or $\dot{\text{P}} \dot{\text{P}} \dot{\text{P}} | \dot{\text{P}} \dot{\text{P}} \dot{\text{P}} |$

long repeated, the form $\dot{\text{P}} \dot{\text{P}} \dot{\text{P}} | \dot{\text{P}} \dot{\text{P}} \dot{\text{P}} |$ resulted. "Bei sehr langsamen Rhythmen verschwindet dagegen die Zusammenfassung mehr und mehr; an die Stelle der Trennung der Gruppen tritt ein allmähliches Uebergehen von der einen Gruppe zur anderen, vermittelt durch das letzte Glied jeder Gruppe, auf; das letzte Glied wird dann als Auftakt angesehen und als solcher enger mit dem ersten Glied der nächsten Gruppe verbunden."

The form which Wundt² considers the earliest three grouping (the amphibrach) was never observed during the course of the experiment, either with children or adults; although, particularly with the adults, the possibility of such an arrangement was given, as will be seen in the later discussion of the method used. For this reason a special investigation with twenty-eight seventh grade children was made, in which this form among others was directly requested. The children were asked to emphasize the second and fifth syllable on each line. With one exception they invariably declared, before reaching the end of the first line, that they were unable to read it in that way, and being asked to try again threw the five lines either into a form something like this $\cup - | \cup - | \cup$ or $\cup | - \cup \cup | - \cup |$. Often, by avoiding a pause at the end of a line, they were able after a line or two to give the remainder entirely in a dactylic or anapaestic rhythm. Some could find no rhythm, and the result was a perfectly irregular rendering, with an occasional syllable louder and longer than the others. One child out of twenty-eight, a girl of twelve, gave the grouping without the slightest hesitation. She read unusually rapidly and in an animated manner. It might be conjectured that the children failed on this form because they had already practiced the other forms; but for this experiment children were selected who knew nothing of the previous experiment, in order that the effect of practice should not prejudice the results. The usual proportion of inversions was noted in the reading of the other forms. But even then, the disparity between the results for the anapaest (the most difficult of the three group), with four inversions out of twenty-eight readings, and the amphibrach with twenty-seven failures out of twenty-eight readings, proves conclusively the artificial and unnatural character of the latter grouping.

¹ Zwei Beiträge zur Psychologie des Rhythmus u. des Tempo. Zeitsch. für Psy., XVIII, p. 126.

² Grundzüge der physiol. Psych., 1893, 4te Aufl., II, p. 86.

The results so far obtained are not in harmony with Miss Smith's statement¹ that there is no such thing as a poor rhythm; that rhythm either is present as a complete and perfect form, or vanishes entirely. There are, on the contrary, several clearly defined stages or degrees of rhythmical perfection or unitariness. While E. A. Poe, in his *Rationale of English Verse*, derives rhythm from an improbable source (the pleasure due to equalities; the simple ear preferring simple equalities, the practiced compound equalities), his order of genesis agrees in several particulars with that which the results of the experiment have led us to make. Poe regarded the rudimentary form of verse as the spondee; later came a collection of two spondees; a third step was the juxtaposition of three words; and monotony finally led to the employment of accent. But the experiments seem to indicate (1) that the earliest rhythm is even simpler than the two-group of Poe; that what has been termed the primary rhythm is the simplest and earliest form. (a) This is modified by the introduction of irregularly recurring accents. Boehme considers this the characteristic arrangement of children's verse.² "Das Kind kennt (wie das Volk) in seiner Dichtung kein jambisches oder trochäisches Versmass, sondern zählt bloss die Hebungen, d. h., die betonten Silben in jeder Zeile; zwischen die Hebungen treten dann die Senkungen (die unbetonten Silben), je eine, oder zwei oder keine, denn die Senkung darf auch fehlen. Herrschend tritt ins Kinderreim das sogenannte trochäische Mass auf."

(2) Next in order comes the simplest two-group, the spondee; two syllables of equal intensity, duration and pitch, separated from the two following by a longer pause than that intervening between each pair of syllables. (a) A trochaic arrangement of the variants, *i. e.*, the accent on the first syllable. This has a number of possible degrees of perfection; in its completest form the last syllable would be subordinated to the first, not only in intensity, but also in duration and in pitch. (b) The second syllable accented or iambic arrangement of the variants. There is considerable variation in the results; for some the dactyl is undoubtedly easier than the iambus, but on the whole we should probably be justified in regarding the iambus as naturally preceding the dactyl.

(3) The three-group. The unaccented form is very rare; it is questionable if the group ever occurs without the presence of a very slight accent upon one syllable. (a) The dactyl is undoubtedly the simplest three-rhythm. (b) The anapæst comes next to the dactyl in order of difficulty. (c) The form

¹ *Op. cit.*, p. 292.

² *Deutsches Kinderlied und Kinderspiel*, Leipzig, 1897, p. 8.

which Wundt regards as the original form of the three-group, if admitted at all, must be regarded as the most difficult. These are all three capable of great variety in arrangement through variations of the different objective factors.

2. THE OBJECTIVE FACTORS: THEIR ARRANGEMENT AND ITS SIGNIFICANCE.

To the mooted question of the importance of a temporal factor in rhythm, Lanier¹ replied that "primordial temporalness is always necessary," and again: "the office of accent cannot begin until after rhythm is established: when accent may be used to suggest various secondary arrangements of the primary rhythmic material; but this office is still absolutely dependent upon time or duration, the sole use of accent being that it recurs at stated intervals of time." Certain poetry, as Tennyson's "Break, break," is dependent for its effect upon measured silences, and must therefore be clearly independent of accent. "If the rhythm were struck by a machine incapable of intensity or pitch difference the rhythm would still be pleasing." Ettlinger² states that the order of grouping is always dominated by the temporal factor. These statements of Lanier and Ettlinger are quite different in their bearing. 'Primordial temporalness,' or in other words regularity of succession, characterizes even the simplest or the primary rhythm. Without it perception of rhythm fails (although Miss Smith³ has shown that slight objective irregularities do not disturb the rhythm, she does not prove that subjective regularity of impressions was not present). Temporalness, in its connotation of regular succession, is the basal principle of rhythm. This, however, is quite another thing than saying that the character of the grouping is dependent upon the time order. Temporal changes can alone (intensity and pitch remaining constant) produce a pleasing rhythm, as has been shown in the results of the experiments; but intensive co-ordination (the temporal relations remaining constant) can also produce a rhythm. When time and intensity conflict, for example, when the shorter is the stronger, it is a question whether the long or the strong syllable will dominate the grouping. The results of the experiments on pitch would indicate that under certain conditions the objectively long may appear shorter and unaccented. Meumann says⁴ that the long syllable because of its greater volume of sound draws the attention to it, and is therefore fitted to introduce a subjective accent. On the other hand, it is equally true

¹ *Op. cit.*, pp. 65, 103, 101.

² *Op. cit.*, p. 182.

³ *Op. cit.*, p. 123.

⁴ *Op. cit.*, p. 404.

that the objectively strong syllable, by virtue of that fact, is focused by the attention and receives a subjective accent. It would seem as if any change, either temporal or intensive, by the very fact of change and through the increased attention which it consequently receives, can bring about a subjective accent or stress. Then the factor, which is best suited to emphasize the fact of change, must have the greatest influence upon the character of the rhythm. Neither time nor intensity, as such, is a determinant of secondary rhythm; but either may be this when translated into terms of subjective accent or stress (*cf.* further discussion).

Position of pause. When several groups were compounded, a short interval followed each group, while a much longer interval followed the compounded group. The long pause with our subjects, as the synchronous readings from the microphone and pneumograph show, always occurred at the time of inhalation. The end of a group was marked by a pause longer than that which separated the syllables of the group. In the dactylic and trochaic grouping, this is the pause preceding the accented syllable. But the interval preceding the accented syllable in the iambic-anapæstic grouping was not always lengthened; although frequently a secondary pause occurred after the accented syllable in the case of the dactyl and before it in the anapæst. In the three-group, the two intervening pauses were ordinarily of the same length. There was still another arrangement noticed in the microphone readings; the first pause was shortest, the second longer, and the third longest. Several orders were observed, in the dactyl — — — — —, — — — — —, — — — — —; and in the anapæst, — — — — —, — — — — —. The second form gave a more unitary character to the whole group. It is the only order which Wundt¹ recognizes. "If in a long series of regular beats, single impressions are emphasized by their greater intensity or by some qualitative peculiarity, one uniform result is the overestimation of the interval preceding and following the emphasized beat." This lengthening is brought about through expectation and relief.—We cannot find Wundt's explanation satisfactory. For (1) at the rate at which sounds must follow each other to produce a rhythmical impression expectation and relief could play no part. Eberhardt² also says that expectation was never present according to his introspection when the rate of succession was less than one second, and then only occasionally present. (2) The arrangement of pauses, which this theory presupposes, is not by any means the

¹ Outlines, Eng. Trans., p. 150.

² *Op. cit.*, p. 109.

only one found, as has already been shown. The long pause occurred most frequently at the end of the group only, the intervening pauses being of nearly the same length. The lengthening of the pause appears rather to be conditioned by the changing of the attention; in the shifting of the attention from one sound to another there must be a psychologically empty time which we call a pause. The apparent lengthening of the pause following the accented syllable is a contrast effect between strong sound and succeeding silence.

Order of syllables. This was not constant. The different arrangements were correlated with clearly defined grades of unitariness in the total impression. In the dactylic grouping, with the microphone reading, the most frequent order was — — — — —; *i. e.*, the duration of the syllables gradually decreases. In the freer renderings of Method I the order was — — — — —; the second and third syllables were of equal duration. The order — — — — —, in which the first was still equal to the sum of the second and third, but the second was shorter than the third, was frequently given. The order noted by McKay and Hurst¹ is the same as that which occurred most frequently in the microphone readings; this appears, on the whole, to be the least perfect arrangement; Meumann and Eberhardt give the order which has been noted as the least frequent but the most perfect. Bolton's² rule for the time order of a group of sounds is not substantiated by the results either with children or adults. His principle is that "a longer sound occurring regularly in a series imposes a grouping according to the number of sounds between the long ones. The long sound is as a rule the last in the group." The subjects must have confused the long sound and the long interval in their report.

Here, as in the ordering of the pause, the unitariness of the impression appears to be in proportion to the degree of contrast; thus the most unitary impression is given by the time order — — — — —. When a group of syllables follow each other in the order Bolton gives, the primary rhythm is still prominent; the separate syllables or sounds are not subordinated to the group, as they are in the grouping just noted. The time relation of the accented syllable to the unaccented was never the relation of two to one, nor could it be expressed by simple numbers: *cf.* Tables. As a rule the accented syllable was but slightly longer than the unaccented. Neither did Wrinch and Shaw³ find the definite time relations $\frac{1}{2}$ and $\frac{1}{4}$ as

¹ Experiments on Time Relations of Poetical Metres, Univ. of Toronto Studies, No. 3.

² *Op. cit.*, p. 231.

³ Contributions to the Psychology of Time, Univ. of Toronto Studies, No. 2, p. 51.

they appear in musical composition. These results are not in accordance with Mach's statement:¹ "So far as I am able to judge, we recognize the identity of time ratios of two rhythms only when they are capable of being represented by very small numbers. Thus we really notice, immediately, only the identity or non-identity of the two times, and in the latter case recognize the ratio of the two only by the fact that one part is exactly contained in the other. Herewith we have an explanation of the fact that, in marking time, the time is always divided into absolutely equal parts." The fact that an intensive change may be substituted for a temporal and the feeling of equality not disturbed argues against Mach's theory. The facts of substitution and the analogous case of the influence of limiting stimuli upon the judgment of short intervals (intervals bounded by strong stimuli are judged longer than equal intervals bounded by weak stimuli) indicates that what we have is not a direct comparison of times but one of subjective stresses.

The Relative Time Values of the Restrained Forms. The total time for reading thirty syllables, in accordance with the four required arrangements, was taken in Method I by means of a stop-watch. The microphone readings are not comparable, as the number of groups given in any one series was indefinite, depending upon the number that could be recorded in one revolution of the drum. Consequently only the results of the readings by Method I have been tabulated.

The figures given in Table XLII represent the average time of the different classes. The asterisk marks the absence of members. The absence of an individual affected the average, increasing or decreasing the time, according to the time of the individual in question; the absences therefore give a greater appearance of irregularity to the results than really existed.

American children. There is a decrease in time required for reading a series corresponding to the age of the pupil. With the boys this holds throughout, from the first to the seventh grade, the change being greatest between the first and the fourth grades. This is undoubtedly due to the slower functioning of the attention in the case of the younger children. The times of the girls of the fourth grade were faster than those for the seventh in the reading of the trochee and iambus. The natural reaction time of the girls of the fourth grade was faster than that of the seventh, but the greater difficulty of the dactyl and anapæst for the fourth grade girls made their time for the reading of those forms slower than that of the seventh grade. The *m. v.* is greatest for the first grade. The effect of practice is not marked, but is most noticeable in the case of

¹ Analysis of Sensation, Eng. Trans., p. 118.

TABLE XLII (a).
Average Times for Different Classes. German Children. Reading 30 Syllables.

INVOLUNTARY.										TROCHEE.										IAMBUS.										DACTYL.										ANAPÆST.			
I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.		I.		IV.											
B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.										
31.5 26.2 27.5 27.4 27.8	34. 33.5 26. 30.6 28.4	29.2 21.7 19.65 19.2 21.1	26.1 21. 20.1 22.05	25. 24.25 20.6 22.9 21.7	20.8 22.3 22.5 21.8 19.5	31.5 28.05 31. 27.26 30.8	31.3 31. 27.26 20.5 20. 21.2	25.8 22.9 20.5 22.5 20.2	22.8 20.2 22.5 21.4 21.2	25. 21.75 22.8 21.5 21.08	18. 18.1 20.96 18.76 19.5	28.7 28.05 32.25 27.4 27.6	24.3 34.06 30.3 31.7 29.6	23.8 22.3 21. 19.5 21.8	22.6 22.2 19.84 20.7 21.	19.8 21.9 21.2 22.1 19.8	21. 19.4 20.6 18.7 18.3	31.5 27.4 29.3 27.3 25.9	38.6 29.3 29.3 27.3 26.3	23.6 20.1 18.05 19.3 18.8	21.5 17.5 19.3 16.9 17.	28.5 19.9 19.8 19.6 15.8	20.4 17.8 17.36 17.1 15.6	27.2 27.5 24.25 27.5 24.1	31.3 35. 30.66 30. 30.	25. 22.85 18.75 18.7 18.5																	
28.08 M.V. 1.36		22.17 M.V. 2.81		22.29 M.V. 1.51		28.6 M.V. 1.16		21.88 M.V. 1.97		22.42 M.V. 1.34		28.8 M.V. 1.38		21.68 M.V. 1.76		20.96 M.V. .93		26.27 M.V. 2.55		19.97 M.V. 1.48		20.72 M.V. 2.22		17.65 M.V. 1.13		26.11 M.V. 1.56		20.76 M.V. 2.53		31.39 M.V. 1.48													
30.5 M.V. 2.64		22.41 M.V. 1.43		20.58 M.V. .83		30.61 M.V. 1.06		21.62 M.V. .65		19.86 M.V. 1.03		29.99 M.V. 2.97		21.26 M.V. .904		19.80 M.V. 1.		30.16 M.V. 3.34		18.44 M.V. 1.57		17.65 M.V. 1.13		26.11 M.V. 1.56		20.76 M.V. 2.53		31.39 M.V. 1.48															

***One member absent.**

TABLE XLII (b).
Average Times for Different Classes. American Children. Reading 30 Syllables.

INVOLUNTARY.										TROCHÆE.										IAMBUS.										DACTYL.										ANAPÆST.									
I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.									
B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.								
22.9	18.2	12.4	17.4	12.5	16.1	23.02	23.1	15.4	23.1	14.45	18.8	30.4	22.3	16.7	19.7	14.2	18.8	29.5	22.4	16.1	19.3	13.2	16.5	30.7	22.	15.1	14.4	24.1	20.	14.4	24.1	20.	14.4	24.1	20.	14.4	24.1	20.	14.4	24.1	20.								
22.2	*17.3	13.9	16.9	*12.2	15.6	24.7	*18.7	14.7	19.5	*12.7	19.1	26.7	*17.5	16.2	*13.1	16.8	28.3	*16.7	15.5	18.5	*12.	16.1	24.1	22.	15.1	14.4	24.1	20.	14.4	24.1	20.	14.4	24.1	20.	14.4	24.1	20.	14.4	24.1	20.									
23.	18.2	14.3	*14.8	13.1	15.6	21.3	19.4	*10.9	*16.9	13.5	18.4	22.2	19.9	15.2	*17.5	13.9	18.3	22.5	18.6	14.1	*15.2	15.7	21.5	19.	13.5	13.5	19.	13.5	19.	13.5	19.	13.5	19.	13.5	19.	13.5	19.	13.5	19.										
19.7	16.1	14.1	14.05	*12.1	17.2	20.9	17.9	*14.7	14.6	*13.	19.	23.3	21.2	*14.9	16.05	*12.4	17.5	22.8	*16.9	13.2	13.7	*12.	15.5	22.6	17.2	14.6	21.7	17.8	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.										
21.6	15.6	15.1	13.3	13.	*16.3	24.1	21.	15.4	15.8	15.2	*17.3	23.3	20.4	15.2	17.5	14.5	*17.5	23.1	17.1	14.5	13.3	*16.	21.7	17.8	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.	13.										
21.88		13.96		12.58		22.8		15.2		13.7		25.1		15.6		13.6		25.24		14.6		12.2		24.1		14.1		24.1		14.1		24.1		14.1		24.1		14.1											
M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.											
1.24		.64		.56		1.36		.42		.79		2.6		.64		.74		2.94		.88		.56		2.68		.66		2.68		.66		2.68		.66		2.68		.66											
17.08			15.29		16.1		20.02		17.9		18.5		20.6		18.23		17.8		18.3		16.		15.96		19.2		14.4		19.2		14.4		19.2		14.4		19.2		14.4										
M.V.			M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.		M.V.										
.97			2.49		.46		1.76		2.24		.74		1.22		1.31		.62		1.76		2.3		.24		1.24		1.24		1.24		1.24		1.24		1.24		1.24		1.24										

*One member of class absent.

TABLE XLII (a).
Average Times for Different Classes. German Children. Reading 30 Syllables.

		TROCHEE.						IAMBUS.						DACTYL.						ANAPÆST.						Rhythm.	
		I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.		Class.	
		B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.		
G.																											
20.8		31.5	31.3	25.8	22.8	25.	18.	28.7	24.3	23.8	22.6	19.8	21.	31.5	38.6	23.6	21.5	28.5	20.4	27.2	31.3	25.	20.5	21.	16.1		
22.3		28.05	31.	22.9	20.2	21.75	18.1	28.05	34.06	22.3	22.2	21.9	19.4	27.4	29.3	20.1	17.5	19.9	17.8	27.5	35.	22.85	18.	22.25	16.45		
22.5		*26.75	27.26	20.5	*22.5	22.8	20.96	*32.25	30.3	21.	*19.84	21.2	20.6	*21.75	27.3	18.05	*19.3	19.8	17.36	*24.25	30.66	18.75	*19.53	19.6	16.6		
21.8		28.2	32.7	20.2	21.4	21.5	18.76	27.4	31.7	19.5	20.7	22.1	18.7	25.9	29.3	19.3	16.9	19.6	17.1	27.5	30.	18.7	17.14	20.2	15.5		
19.5		28.5	30.8	20.	*21.2	21.08	19.5	27.6	29.6	21.8	*21.	19.8	18.3	24.8	26.3	18.8	*17.	*15.8	15.6	24.1	30.	18.5	*17.6	*18.05	15.9		
		28.6		21.88		22.42		28.8		21.68		20.96		26.27		19.97		20.72		26.11		20.76		20.62			
20.58		M.V.	30.61	M.V.		M.V.	19.86	M.V.	29.99	M.V.	21.26	M.V.	19.80	M.V.	30.16	M.V.	18.44	M.V.	17.65	M.V.	31.39	M.V.	18.55	M.V.	15.71		
.83		1.16	1.06	1.97		1.34	1.03	1.38	2.97	1.76	.904	.93	1.	2.55	3.34	1.48	1.57	2.22	1.13	1.56	1.48	2.53	1.17	1.2	.61		

*One member absent.

TABLE XLII (b).
Average Times for Different Classes. American Children. Reading 30 Syllables.

II.	TROCHEE.						IAMBUS.						DACTYL.						ANAPÆST.						Rhythm.	Class.
	I.		IV.		VII.		I.		IV.		VII.		I.		IV.		VII.									
	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.	B.	G.								
G.																										
16.1	23.02	23.1	15.4	23.1	14.45	18.8	30.4	22.3	16.7	19.7	14.2	18.8	29.5	22.4	16.1	19.3	13.2	16.5	30.7	22.	15.1	21.3	11.05	15.5		
15.6	24.7	*18.7	14.7	19.5	*12.7	19.1	26.7	*17.5	16.2	20.7	*13.1	16.8	28.3	*16.7	15.5	18.5	*12.	16.1	24.1	*20.	14.45	16.5	*11.5	15.1		
15.6	21.3	19.4	15.9	*10.9	13.	18.4	22.2	19.9	14.9	*17.5	13.9	18.3	22.5	18.6	14.1	*15.2	11.1	15.7	21.5	19.	13.5	*14.6	11.5	16.		
17.2	20.9	17.9	*14.7	14.6	*13.5	19.	23.3	21.2	*15.2	16.05	12.4	17.5	*16.9	15.7	13.7	*12.	15.5	22.6	17.2	*14.6	13.8	*11.6	14.3	14.3		
*16.3	24.1	21.	15.4	15.8	15.2	*17.3	23.3	20.4	15.2	17.5	14.5	*17.5	23.1	17.1	14.5	13.3	12.6	*16.	21.7	17.8	13.	14.1	12.6	*15.2		
	22.8		15.2		13.7		25.1		15.6		13.6		25.24		14.6		12.2		24.1		14.13		11.65			
M.V.	M.V.	20.02	M.V.		M.V.	18.5	M.V.	20.6	M.V.	18.23	M.V.	17.8	M.V.	18.3	M.V.	16.	M.V.	15.96	M.V.	19.2	M.V.	16.06	M.V.	15.2		
.46	1.36	1.76	.42		.79	.74	2.6		.64		.74	.62	2.94		.88	2.3	.56		2.68		.68	2.61	.38	.42		

*One member of class absent.

the girls. In the involuntary grouping of the boys of the fourth grade the rate of succession in the later series is slower than in the earlier. The reason may be that because of its great regularity it offered less and less interest. Throughout, the times for the boys of the seventh grades are faster than those for the girls of the same grades. The values given for the boys and girls of the first grade do not represent the time values for the dactyl and anapæst, as they failed to produce those rhythms. In general, then, the three-groups are shorter than the two.

German children. The time values are much slower than for the Americans. With the girls the decrease in time required runs parallel with increase in age, but with the boys (excepting for the anapæst and iambus) the fourth grade read more rapidly than the seventh. The effect of practice is greatest in the cases of dactyl and anapæst. The results are not so unequivocal as with the American children. The three-groups are slightly shorter than the two-groups.

These results, as far as they go, are in harmony with the results obtained by other investigators. The inherent difficulty of the more complex forms for the younger children obscured the general principle. For a satisfactory comparison of the time values of the different rhythms, the investigation must be carried on with adults. It is, however, clearly shown that the times for the three-groups are shorter than those for the two-groups. The three-group divides the series of sounds into fewer unities and naturally shortens the time for the total series. Within certain limits the number of sounds in a group appears to depend upon the rate of succession. Bolton's Subject 2 says: "Slower than a certain rate no rhythm is felt. With more rapid rates two clicks form a group. Faster still four clicks form a group with the primary accent on the first, the secondary on the third, and an interval after the fourth; a still more rapid rate gives an eight group. At some rates I was able to get a three rhythm accented strongly on the first."

The fluctuation in results will not warrant a comparison of the results for trochee and iambus or for dactyl and anapæst. Hurst and McKay¹ found that the foot in the iambus and anapæst tended to be longer than that in the trochee and the dactyl; that the trochee and dactyl were therefore used more frequently for stirring and rapidly moving verse. Rate of succession had a similar effect upon several of our subjects, who in comparing the two and the three group discs found that the three-grouped (rate of succession being more rapid) were enlivening and exciting, while the two-grouped were dull. "With fast rates intensive changes recur more rapidly and hence call

¹ *Op. cit.*, pp. 166 ff.

for more rapid muscular movement. On this account fast rates were found to be exhilarating and animating, and slower drowsy and soporific." If expectation played any part in mediating the grouping, we should expect the iambus and anapæst to be shorter than the trochee and dactyl. That the opposite is the case is an argument against the expectation theory of Wundt.

Arrangement of Intensities. In the two-group the strongest and longest naturally come first. They can, however, have a second place. Only in cases of partial inversion are the longest and strongest separated. The lengthening of the accented syllable follows naturally from the greater muscular strain and increased attention which are given it. In the three-group (dactyl) there were several arrangements given dependent upon the more or less perfect subordination of parts within the group. The forms noted were (a) ———' ——— ——— or (b) ———' ———' ——— or (c) ———' ——— ———'. The arrangement (a) was very frequent, (b) less frequent; the most satisfactory form was (c). These results do not agree with those of Bolton,¹ who notes only form (b), and gives as a principle that, when series of impressions made up of three or four intensities recur in a sequence, they are so arranged that the impressions are subordinated to one another as nearly as possible from beginning to end. Bolton also finds four arrangements of intensities possible; but it is very doubtful if we can directly compare more than three intensities, and can therefore have more than three grades of accentuation in a group. Eberhardt² does not find the arrangement Bolton gives; on the contrary, he notes arrangement (c) as the most natural form of the three-grouping. This is certainly a closer grouping, and gives an impression of greater unity than form (b). In it, the first is accented by contrast with the second and the third by contrast with the second, and the whole group appears to form a closed circuit; while in the last form there is a feeling that there might be still another step in the graded series before the end is reached. In other words, the subordination of the whole group to the accented syllable is greater by this arrangement.

Pitch Relations.

The question now presents itself whether quality can be

¹ *Op. cit.*, p. 226.

² *Op. cit.*, p. 123. "Fernersei über das Betonungsverhältnis des zweiten und dritten Gliedes bemerkt, dass die von der Metrik verlangte Betonung des zweiten Schlates gegenüber dem dritten nicht stattgefunden hat; im Gegentheil scheint es, als werde stets der dritte Schlag minimal stärker betont als der zweite, wenn auch die Zahlen die dann vielleicht zu erwartende Verlängerung des dritten Gliedes nicht durchgehends aufweisen."

called a determinant of rhythm in the same way and with the same degree of constancy as time and intensity, or whether it merely increases the intensive effect. As previously noted, the more frequent occurrence of P. and I. together, rather than P. and T., might be so interpreted. Meumann appears to be of this opinion.¹ "Accent is, finally, never a mere increase in intensity but also an increase in pitch; increase of pitch as well as of intensity appears to serve the purpose of bringing out the logically and emotionally more important." The stronger and longer tone was nearly always the higher in the spoken rhythm, though there were many more cases of inversion in pitch than in either time or intensity. Several children always spoke of the stronger tone as the higher (this was without suggestion on our part, and the remark was always left apparently unnoticed). Not infrequently the longer, higher and stronger was accompanied by a raising of the whole body. Meumann also remarks that high notes are apparently more intensive than low notes of the same intensity. A contrary statement is made by Abraham and Schaefer.² "Wie für die Analyse des Akkordes, so wurde auch für die Bestimmung des Rhythmus der tiefste Ton unwillkürlich als erster Ton gewählt, wohl in Folge musikalischer Gewohnheiten. Er schien stärker aus der Tonfolge herauszuspringen, so dass es Mühe machte, mit einem andern den Rhythmus beginnen zu lassen." There appear to be three possible interpretations of the facts; either pitch is not an independent determinant of rhythm; or, being such, the higher is the accented; or again, in accordance with Abraham and Schaefer, the lower is the accented tone. In order to gain a more satisfactory answer, another series of experiments was made. The first experiment gave the qualitative relations of the motor rhythm only; the object of the second was to determine qualitative relations in a sensory rhythm, to determine whether the higher and lower tones had a constant position in the grouping, or if their position was dependent upon some secondary factor. It was necessary for such an investigation to get a series of tones that should vary only in pitch. For this purpose an apparatus was devised in the psychological laboratory at Cornell University.

Apparatus. Two electrically driven forks cased in sound proof boxes were the source of sound. At first the c^1 of 256 and the c^2 of 512 double vibrations were used; but the interval was too large to be satisfactory, and the a^1 of 435 was substituted for the c^1 of 256. A resonator was placed just above each tuning fork. Rubber tubes led out from these resonators, and ended at some distance from the boxes in small

¹ *Op. cit.*, p. 402.

² Ueber die maximale Geschwindigkeit von Tonfolgen: *Zeits. für Psy.*, XX, p. 415.

pieces of glass tubing, which were securely fastened to two wooden standards. In front of these standards discs were revolved. On the opposite side of the discs, a^1 and c^2 resonators were adjusted so as to catch their respective tones; by means of tubing the tones were carried to the ear of the subject. Nine discs were used. *Disc (1)*. For comparison of subjective rhythm—if the subjects were so inclined—with the rhythms objectively caused by variations in pitch, this disc had two circular slots 90° long, $1\frac{1}{2}$ cm. wide and 13 cm. from the center of the disc. These were on opposite sides of the disc. Thus the disc shut off the tone coming from the c^2 fork, allowing only that from the a^1 to pass through; as the tone was successively given and cut off, for an interval equal to the time required for the disc to make one-fourth of a revolution, the successive tones and intervals were of equal duration. *Disc (2)* had two slots, one of which was 4 cm., the other 13 cm., from the center of the disc. Each of these formed an arc of 90° ; and the successive sounds and silences were of equal duration, but varied in pitch. *Disc (5)* was made for the comparison of the subjective rhythm with the objectively conditioned three-group. It had three slots of 60° each, 13 cm. from the center of disc. *Disc (6)* had three slots, two of which were 13 cm. and the third 4 cm. from the center. It thus gave two tones from the a^1 fork to one from the c^2 . The duration of all the tones and intervals was equal, lasting for an interval equal to the time occupied by the rotation of the disc through 60° . *Disc (7)* had three slots; two 4 cm., one 13 cm., from the center. All arcs of 60° . The resulting rhythm was objectively composed of two tones from the c^2 fork and one from the a^1 ; these were of equal duration together with the intervening intervals. In order to ascertain if an increase in duration of one of the tones would change the rhythm already established, in *disc (3)* the slot admitting tones from the a^1 fork was increased, at first by an increment of 30° . Later 15° more were added. The resulting rhythm consisted objectively of two tones, that from the a^1 fork being one-half again as long as that from the c^2 . *Disc (4)*. The same number of degrees was added to the slot admitting tones from the c^2 fork. The resulting rhythm was a two-group, the reverse of that given by disc (3). *Discs (8) and (9)*. The slots admitting the tones from the a^1 and c^2 forks respectively were increased at first by increments of 15° ; later 15° more were added. The resulting rhythms were three-groups, in which one tone was longer than the other two.

The time occupied by one rotation of a disc was approximately one second. The chief difficulty with the above apparatus or with any, for that matter, which might be devised, was in the regulation of the intensities of the two forks. There was no means of objectively regulating the intensities; recourse for that reason must be had to a subjective regulation. This necessitated a preliminary experiment for each series.

Preliminary Experiment. The subject sat with back to apparatus and experimenter, and at some distance from the resonator. In order to avoid all suggestion of rhythm in getting the intensity judgments, the discs were not used. Instead, at the first signal one tone was given for three seconds, at another signal the other tone was given for an equal time; and judgment as to the intensity of the two tones was passed. After a few preliminary judgments (to ascertain the nature and direction of difference), it was possible by increasing or de-

creasing the amount of resistance to the current as the judgments might indicate, to reach a nearly liminal difference. The method of procedure was then in the main that of Right and Wrong Cases. When evidence was given, through constancy in the direction of judgment, that there was subjective difference in intensity, the resistance was slightly increased or diminished in accordance with the direction of judgment. This procedure was kept up until a series of thirty judgments was obtained, in which there was either no constancy in the judgment, or both tones was judged equal. This result warranted the presumption that there was no subjective difference in intensity. Nearly all the subjects experienced great difficulty, when giving their judgments, in abstracting intensity from quality. Some judged the higher tones as "nearer" and therefore louder; others the lower tones as "bigger" and consequently louder. For this reason the two forks first used were very unsatisfactory; with an interval of a minor third the difficulty was not so great, and near the limen a few of the subjects, who were decidedly unmusical, confused the pitch of the two tones as well.

Having then the conditions for the experiment (equality in time and intensity), we proceeded to use the discs. Sometimes the two-grouped were given first, at other times the three-grouped. Discs 1 and 5 were given sometimes before and sometimes after the others of their respective sets. But the two-grouped and the three-grouped were always given separately. It was found more satisfactory to let the subject determine the time for hearing each rhythm; he attended to each, until he was fully satisfied, and then reported immediately.

The subjects were Mr. I. McKay, rhythmical, no musical training, considerable training in introspection; Mr. W. McKee, some training in introspection, no musical training; Miss M. F. Winger, considerable training in introspection, unmusical; Mrs. E. V. Bentley, musical, some training in introspection; Mrs. B. Brooks, some training in introspection, no musical training; Miss E. Parry, some training in introspection, no musical training; Miss C. Seymour, some training in introspection, no musical training.

The subjects made their reports in such form of metrical notation as they might find individually convenient, and not in the form that appears in the Tables. They were thus able to give their report while the rhythm was in full swing. For the sake of clearness, the reports have been tabulated in the form given, and occasional interpretatory remarks of the subjects have been added.

Results. While there was no general constancy in the accentuation of the high or low tones, *i. e.*, no constancy for *all* individuals, there was a marked constancy in the interpretation of the *same* individual throughout the different series given. Some individuals were inclined to hear the high as the more intense, others the low. The subjects may be divided

TABLE XLIII.

Two-grouped rhythm. c of 256, and a of 453 vibrations. All tones and intervals of equal duration with the exception that a in disc 3 and c in disc 4 are increased by a temporal increment of 1-6.

Disc no.	I.	2.	3.	4.
Objective Rhythm	a a a a a a	a c a c a c	a c a c a c	a c a c a c etc.
Subjective. B. B.	No grouping.	A two-grouped rhythm; higher tone is first and longer; it appears to approach and the lower tone recede.	The lower tone is longer, is more intense and comes first in the group.	
I. M.	A two-grouped; first longer and more intense.	Low tone is first and is longer; it appears to be the integral part of the foot.	While higher tone is sharper the lower appears to be stressed muscularly. Lower tone first in group but higher is longer.	Rhythm same as with disc 2.
W. M.	No grouping.	Lower tone is first, is longer and more intense.	Rhythm same as with disc 2.	The higher tone is <i>first</i> but lower tone is longer and is more intense.
F. W.	All tones of equal duration and intensity; can group by 8s, 4s, 2s or 3s.	Lower tone appears to be first but higher; is longer and is a c e n t e d; tried to change the accent but could not.		A six-grouped rhythm: at first it appeared to be a simple two-group, but later noticed that there were three long and three short in each group; accent was on the <i>first</i> long. The higher tone is first and is longer.
C. S.	All tones of same pitch, but grouped into 2s; first is longer and is more intense.	Higher tone is first is longer and is more intense.		The lower tone is first, but higher is longer and stronger.

TABLE XLIV.

Three-grouped rhythm; c of 256 vib. and a of 453 vib. All tones and intervals of equal duration with the exception that a in disc 8 and c in disc 9 are increased by a temporal increment of 1-4.

Disc no.	5.	6.	7.	8.	9.
Objective Rhythm.	a a a a a	a c c a c c	c a a c a a c a a	a c c a c c a c c	c a a c a a etc,
Subjective. B. B.	No grouping.		Lowest last in group; both high tones accented; the first high is longer than the second, also stronger.		
I. M.	A two-group; the first tone slightly longer and stronger than the second.	The higher is first and is longer. The two low tones are of about equal duration. The first is separated by a long interval from the second.	At first the lower tone has the first place in the group; later it has the last place. The lower tone is longer and is accented.	Rhythm same as with disc 6; the high tone has a stronger accent than in that rhythm.	The two high tones are longer and are accented; but the low tone has first place in the group.
W. M.	No grouping — but if I think of the clock, the tones are grouped in a two-rhythm and the first is accented.	The higher tone is first; it is longer and is accented.	Two distinct parts to each group. The two low tones are shorter and are separated by a long interval from the higher tone which comes last, although longer and accented.	Rhythm much same as with disc 6; but interval between 1st and 2d tone is quite long.	Much same as 7; but not so pleasant; it does not hold together as well.
F. W.	Can group by 8s or 4s.	The higher tone is first; it is longer and stronger. The two low tones are of equal duration and intensity.	The first tone is lower, is shorter, but is accented; the second and third tones are longer than first and are higher; and at last the accent is placed upon the two higher tones.	The first tone is higher, is longer and is accented; the second and third appear to be of equal duration, intensity and pitch. Long intervals follow the first and third tones.	The first tone is short and is low. The second and third are longer and higher, the second is accented.
C. S.	A two-rhythm.	The first is longer and stronger than the second and third.	Finds no pitch difference; the first is longer and is accented.	Same rhythm as with discs 6 and 7.	

TABLE XLV.

Two-grouped rhythm; a of 453 vib. and c of 512 vib. All tones and intervals of equal duration, with the exception that c in disc 3, and a in disc 4 are increased by a temporal increment of 1-6.

Disc no.	I. a a a a a	2. c a c a c a	3. c a c a c a	4. c a c a c a etc.
Objective.				
Subjective. B. B.	No grouping.	First tone is longer and higher.	First tone is higher but shorter, the second longer and lower.	The second tone is higher, longer and is accented. (This subject confuses high and low.)
I. M.	A two-rhythm; first tone longer and more intense.	First tone is longer, higher and accented. The second is a bagatelle at the end of first, to make up a horse's gallop.	Indistinguishable from rhythm of disc 2; whole is slower and not so clear cut.	Same as 2 and 3.
W. M.	No grouping; by effort can throw it into a two-rhythm.	First tone lower, longer, and more intense.	First tone higher, but the second longer and more intense.	No great difference in the length of the two tones. The first is slightly longer and more intense; it is the lower tone.
F. W.	All alike; can group by fours, eights or threes.	No temporal difference. The first tone is higher and more intense.	The first tone is higher, but can change accent at will.	
C. S.	A two-group with first tone longer and stronger.	The second tone is more intense, and is longer. No pitch difference.	The first tone is lower and longer.	Same as with disc 2, accent very slight. (This subject apparently does not perceive pitch differences of a minor 3rd.)
E. P.	A two-rhythm; reminds her of the ticking of a clock.	No difference in intensity, but the first is longer and higher and receives the accent.		Same as with disc 2.

TABLE XLVI.

Three-grouped rhythm; a of 453 vib. and c of 512 vib. All tones and intervals of equal duration with the exception that c in disc 8 and a in disc 9 are increased by a temporal increment of 1-4.

Disc no.	5.	6.	7.	8.	9.
Objective.	a a a a a	c a a c a a	a c c a c c	c a a c a a	a c c a c c
Subjective. B. B.	A two-group; first longer and more intense.	The longest and lowest is last; it is least intense, the second is most intense.	The highest is first, it is longest. It appears to sound through the others like the air to a bass accompaniment.	The first is highest, longest and strongest. The second and third have same pitch, duration and intensity.	The highest is longest and most intense; it may be either first or last in the group. (High and low are confused.)
I. M.	A two-group; but no distinguishable difference in tones.	The highest is first, but second and third are longer and more intense. The second is longer than the third.	The lowest is first, it is longest. Second and third are of equal duration.	Same as rhythm of disc 6.	Same as with disc 7.
W. M.	No grouping, even with great effort.	The highest is shortest; it may come first or last. The other two are longer and more intense and equally so.	The two higher are shorter but are both accented. The lower tone comes last in the group.	Same as rhythm of disc 6.	Same as 7. Both 7 and 9 are annoying and unstable.
F. W.	All alike; but can arrange in any grouping; when subject gives up to rhythm, it falls into groups of twos.	The higher tone is first; it is more intense, but the two lower tones are longer.	The higher is first, longer and more intense. The second and third are lower and of equal duration and intensity.		Same as 7.
E. P.	A four-rhythm broken into groups of twos.	The higher is shorter and comes last; it is separated by a long interval from the second. The first and second are of equal duration and intensity.	The higher is first and more intense than the second and third, although it is shorter. The two lower are of apparently equal duration and intensity. (High and low are confused here.)	Rhythm same as with disc 6.	Same as 7, except that the first and most intense tone is also the longest.

TABLE XLVII.

Two-grouped rhythm: a of 453 vib. and c of 512 vib. All tones and intervals of equal duration with the exception that c in disc 3 and a in disc 4 are increased by a temporal increment of 1-3.

Disc no.	1.	2.	3.	4.
Objective.	a a a a a	c a c a c a	c a c a c a	c a c a c a
I. M.	A very poor two-rhythm; sometimes none at all, at other times the first is stressed.	The first is longer. This is a natural rhythm. Subject notes no difference in pitch or intensity.	First tone is longer and higher but lower is accented. The high tone comes with a long inspiration, the low with the expiration, and is more rapid, full and of greater strength.	The high tone is first but is shorter than the low tone which is accented. It is an odd and decided rhythm.
F. W.	No accent; can group in twos.	Higher is first, it is longer, a dragging tone. The lower is more concise; it is accented.	The higher is longer and more intense; it is first in the group.	The higher is first, but it is shorter than the lower tone; could not tell at first how this rhythm varied from that of discs 2 and 3.
E. P.	A two-group; first slightly longer.	The higher tone comes first, is longer and more intense; the second seems like an echo of the first.	Same rhythm as with disc 2, but higher tone is longer and the interval following it shorter.	The higher tone is first and is accented; it is about 3 times as long as the low tone. (Confusion of the higher with lower by this subject.)
E. V. B.	A four-grouped rhythm; first tone accented.	Lower tone comes first and is accented but both tones are of the same duration. Rhythm is jerky.	The lower tone is first and is accented, although the higher is longer.	The lower tone is first, is longer and more intense. (This subject shows a strong tendency towards accenting the lower tone.)
E. V. B. (On second day).	A four-grouped rhythm. Monotonous.	The lower tone is longer and stronger and is first in the group.	The lower tone is first and is accented; the higher is longer and seems as if sung with inspiration.	The lower tone is longer and stronger and has the first place in the group.

TABLE XLVIII.

Three-grouped rhythm; a of 453 vib. and c of 512 vib. All tones and intervals of equal duration with the exception that c in disc 8 and a in disc 9 are increased by a temporal increment of 1-2.

Disc no.	5.	6.	7.	8.	9.
Objective.	a a a a a	c a a c a a	a c c a c c	c a a c a a	a c c a c c
I. M.	A two-group. The first tone is a little louder and longer; but this difference may be destroyed by analytic attention.		The higher is longest and most intense; it is first. The other two are of equal duration and intensity.	Same as 7.	This seems different; but can't tell in what the difference consists.
F. W.	Most pleasant grouping is by eights, can group by fours, threes or twos.	The higher tone is first; it is shorter, although more intense than second and third. The second tone is longer than the third.	The higher tone is longer and more intense than the two lower tones. (Confusion of high and low.)	The higher tone is first, is longer, and more intense. The shortness of the interval after the first makes the dis seem in a hurry.	The higher tone is last but is longer and more intense than the two lower. (Same confusion here.)
E. P.	Same tone; group of eight broken into fours. Primary accent on second tone, secondary on fourth.	All tones are of same duration but the higher is more intense.	The higher is longer and more intense, and first in the group. The second and third are of same pitch, duration and intensity. (Evident confusion of high and low.)	All tones are of the same intensity and duration; the first tone is the highest, the second and third are of same pitch and lower than first.	Same as 7. (Confuses high and low.)
E. V. B.	A four-grouped rhythm: first group accented; unpleasant by contrast with other rhythms.	Two lower tones are longer and more intense than the higher; the first of these is longer and more intense than the second. High tone is last.	The low tone is longer, stronger than the two higher, which are of equal duration and intensity. This rhythm is pleasanter than 6.		Resembles rhythm of disc 7. All tones of equal duration.
E. V. B. On second hearing.	Something like 1, but higher, quicker and brighter.	Report same as on previous day.	Report practically same as on previous hearing. No interval between second and third tones.	Rhythm same as with disc 6. (High, although objectively, longer, is heard as shorter.)	Same as rhythm of disc 7, except that the difference in the duration of the accented and unaccented is much greater than in that case.

into three classes,—those who accented the high tones, those who accented the low, and those to whom highness and lowness, as such, were a matter of indifference. With these subjects, in the three-group the accent fell upon the tone which was different from the other two in the group: $c^1 a a$ or $a^1 c c$; *i. e.*, either c or a might be accented. The constancy with which the low tone was accented in the case of E. V. B. was very marked. With Disc 6, where the objective arrangement gave two low tones and one high, had there been no constancy in her interpretation of difference in pitch, the high tones as different from the other two would have been accented. On the contrary, she accented and lengthened the *first low* in both series given. In the case of Disc 8, the results show in a most striking manner a natural tendency to accent the low tone; here c is objectively lengthened, being one-half again as long as either a ; it also, as in the arrangement of Disc 6, occurs but once in every three tones. It would seem in this case that the objective conditions must of necessity determine the rhythm. But, on the contrary, the *first a* is heard as *longer* and stronger. In Disc 3 the high tone is objectively longer. E. V. B. still gives the accent to the low tone, although the high is judged longer. For this subject, pitch is not only a constant determinant but also a more effective determinant than time, as judgments upon Discs 3 and 8 show. E. V. B. had had a considerable musical training; in fact she was the only 'musical' subject.

W. M. showed the same tendency. Where the interval was only a minor third, the low tone was invariably subjectively lengthened, and with but one partial exception accented. Even in the case of Discs 6 and 8, the subjective rhythm was the same as for E. V. B. With Disc 3, although the objective lengthening of the high tone resulted in giving it the first place in the group, the low tone was judged longer and more intense. But with the larger interval, the subjective rhythm for Disc 6 corresponds with the objective order; although the high tone was subjectively accented, it was (curiously) judged as lower. With Disc 8 not only the high but also the first low was accented.

E. P., although she almost invariably judged high low and low high, was strongly inclined to accent the objectively low, even though the judgment resulted in a seemingly distorted rhythm.

Other subjects were fully as determined to accent the high. F. W. was typical of this class. In her preliminary intensity judgments it was necessary to make the high tone considerably weaker than the low (on the basis of the judgments of the other subjects) in order to get a judgment of equality. As a

rule, the high tone came first in the group. Disc 9, when arranged in accordance with the objective order, was said to be unpleasant; this was undoubtedly due to the compulsion which the objective lengthening of a low tone (and the arrangement one low to two high) exerted upon F. W.'s natural grouping. Here, as with *W. M.*, high and low were confused. When F. W. accented the low tone, she called it the high. The tendency of C. S. was in the same direction. One great difficulty in interpreting the results for the two-group was the determination whether subjectively high and low corresponded to objectively high and low; in the three-group the arrangement of the three tones gave a basis for determination. When confusion of judgment was found in the three-group, the presumption was that it was present also in the two-group.

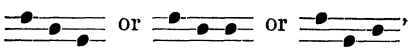


B. B. and *I. M.* were examples of the third type. Pitch was for them not a constant determinant of rhythm. The subjective order was determined by change of any sort; in a three-grouping consisting of two high and one low, the low was accented; but if the arrangement gave two low and one high, the high was accented. "Awareness of change" seems for these subjects to be the determinant of rhythm.

In the light of these equivocal results, how are we to interpret the great constancy with which the accented tone in a motor rhythm was raised in pitch? It will be remembered that cases of inversion in pitch were more frequent than in time or intensity; but even then the percentage was very low. What does increase in pitch mean for the producing subject? *An increase of intensity is quite probable, because of the necessary increase in the force of a blast of air to produce a heightening of pitch.*¹ This is in perfect accord with the results of the experiments on the motor rhythm, in which intensive and pitch differences were nearly always correlated. Pitch, then, is a constituent and constant factor in the spoken rhythm, but not necessarily as a qualitative determinant. Because of physical and physiological conditions it is an accompaniment of any intensive change. It is only an intensification of the intensive factor. In the sensory rhythm, the criteria of the spoken rhythm (strain sensations and tension in the trachea and vocal organs) were absent, unless there had been strong associations set up. Neither was there a physical or physiological reason for the constant appearance of variation in pitch. Pitch in the sensory rhythm owes its direction and constancy, when they are present, to the character and force of the individual associations. Where, as with *E. V. B.*, musical training has given strength

¹Text book of Physiology, edited by E. A. Schäfer, 1900, Vol. II, p. 127.

and constancy to the association, we find that pitch has great effectiveness as a determinant of rhythm; but with subjects who have few associations of an unequivocal character, pitch as such can scarcely be said to determine the rhythm. It is not necessary that the association be of a musical character for it to have considerable constancy. The associations were very frequently of a spatial character; high was "nearer," low was "farther away;" low was "big," and high was "thin." One subject spoke of the high tone as "a silly little appendage." Still another subject was governed largely by spatial associations of another character; he placed the high tone in the top of the head, the other at the base of the skull, and experienced a 'flipping' from the one position to the other as the tone changed.

We can, then, say that quality is not an independent determinant of rhythm; it can be considered either as a substitute for or as an intensification of intensity,—whether because of strain sensations common to both, or because of associations which, reduced to their ultimate grounds, are of an intensive character.

In the arrangement of the tones as to pitch, owing to objective conditions (only two forks being used), the order was necessarily either high-low or low-high. Both of these occur with nearly the same frequency. In the motor rhythm, the orders for the three-group were  or  or , of which the third was the most pleasing; probably for the same reason that intensities arranged in a corresponding manner ———— give a more pleasing impression. Such a group has a more unitary character. It would be interesting to obtain the judgments of adults as to the more or less satisfactory character of these different arrangements; but the necessary time was wanting.

The subjects, when questioned as to the course of the attention and its effect upon the rhythm, were unanimous in declaring that they attended to a group as a whole; it was the unit of attention. This tendency was so strong that it was frequently difficult for subjects to analyze what they had heard, although they 'felt' differences between the various rhythms. With E. V. B. it was always necessary to reproduce the rhythm by humming it before she could make an analysis.

Some of the remarks of the different subjects with regard to attention are given below. B. B. "The sounds were all loud at first, then became less distinct for a brief space, after which they were stronger again." "I tried to keep the sounds from growing fainter by concentrating the attention upon them, but succeeded only in prolonging the stronger." I. M. "The unit of attention was the foot; the character of the foot was determined by the accent of the syllable which

was the center of attention." "An attempt to inhibit the muscular movements makes the whole rhythm appear more uniform. The withdrawal of the attention seems to obscure the rhythm and cast it out of consciousness. I do not think the rhythm would disappear if I could attend to the tones and at the same time inhibit my movements." E. P. "The natural course of attention is from group to group." W. M. says of Disc 9: "When attention wavers the pattern can be changed, the different forms come and go rapidly." E. P. "Attention was upon the melody in general, but occasionally when analysis was somewhat difficult or combination unpleasant the attention wandered off to the separate tones, their duration, quality, etc."

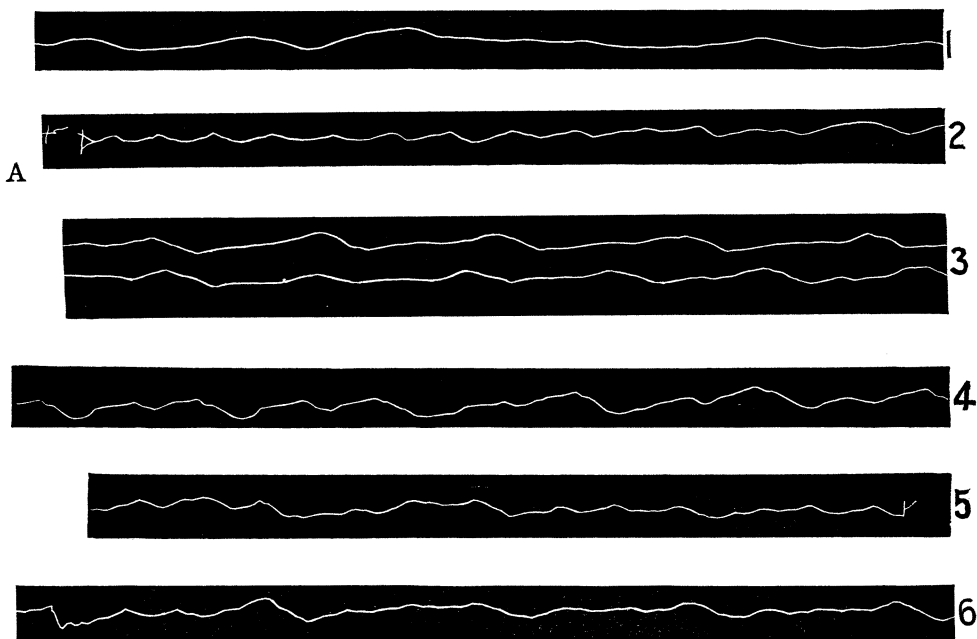
Accent. The subjects were not questioned as to the nature of their subjective accent; but finding interesting data on that point in their reports, data bearing upon the whole question of perception of rhythm, we collated them and give them with the name of the subject.

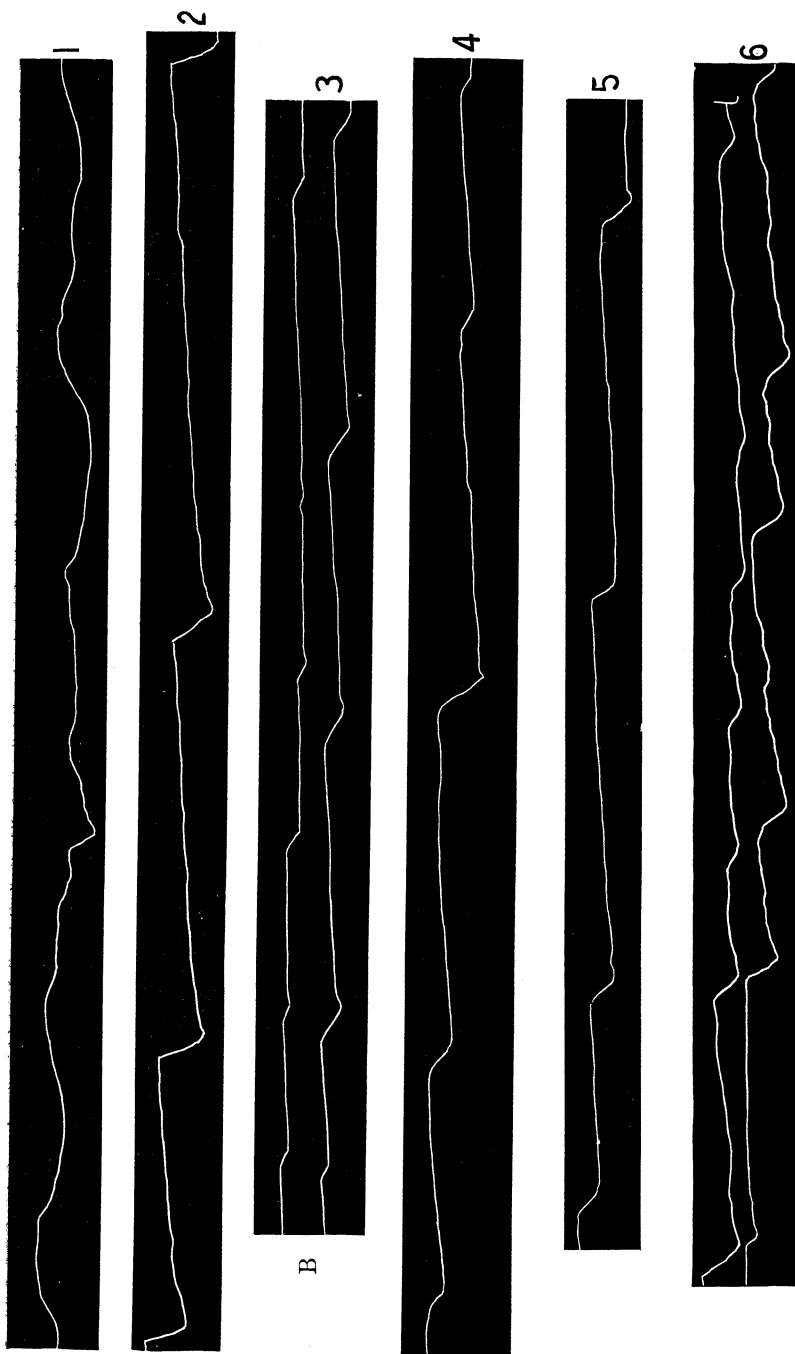
I. M. says with regard to Discs 5 and 6: "It is impossible to tell where the stress is in the feet. When I pay attention to intensity, pitch and duration they appear to be equal in each; so that the stress does not appear to lie in any one of them. There are of course the muscular sensations, but it is difficult to believe that there is not an objective rhythm." F. W. says of Disc 3: "The two tones take the accent equally well. The high one because it naturally comes first and seems to give the push or impulse to the whole thing. The second note could take it because it seems to be stronger and has a longer interval after it; I can change the accent at will." I. M. says with regard to Disc 1: "When I succeed in obtaining a rhythm, the first is more stressed and a little longer than the second, in which case there also appears to be some difference of quality but not of pitch." He says of Disc 3: "The high tone appears to be given with an inspiration, which is long, the low with an expiration, which is rapid, full, and stronger." E. P. says of Disc 2: "The higher is accented, but both are of approximately equal intensity." And with regard to Disc 6: "The three tones are of equal intensity but the accent falls on the two low tones." F. W. says of Disc 4: "Not easy to accent, but a little easier to accent the long. I can put it on the high and short, but do not like it so well. Moving the fingers helps placing of accent." With regard to Disc 1: "I cannot accent it. Tried to place it but it fell on all." On the same day, she says of Disc 2: "Main accent is on the long, but short and high is slightly accented too." With regard to Disc 6: "Perhaps the strongest accent is on short and high. Can put it on the first long but not on the second long." B. B. says of Disc 4: "The low tone is longer and usually more intense; sometimes the high seemed more intense; could change the accent by attention."

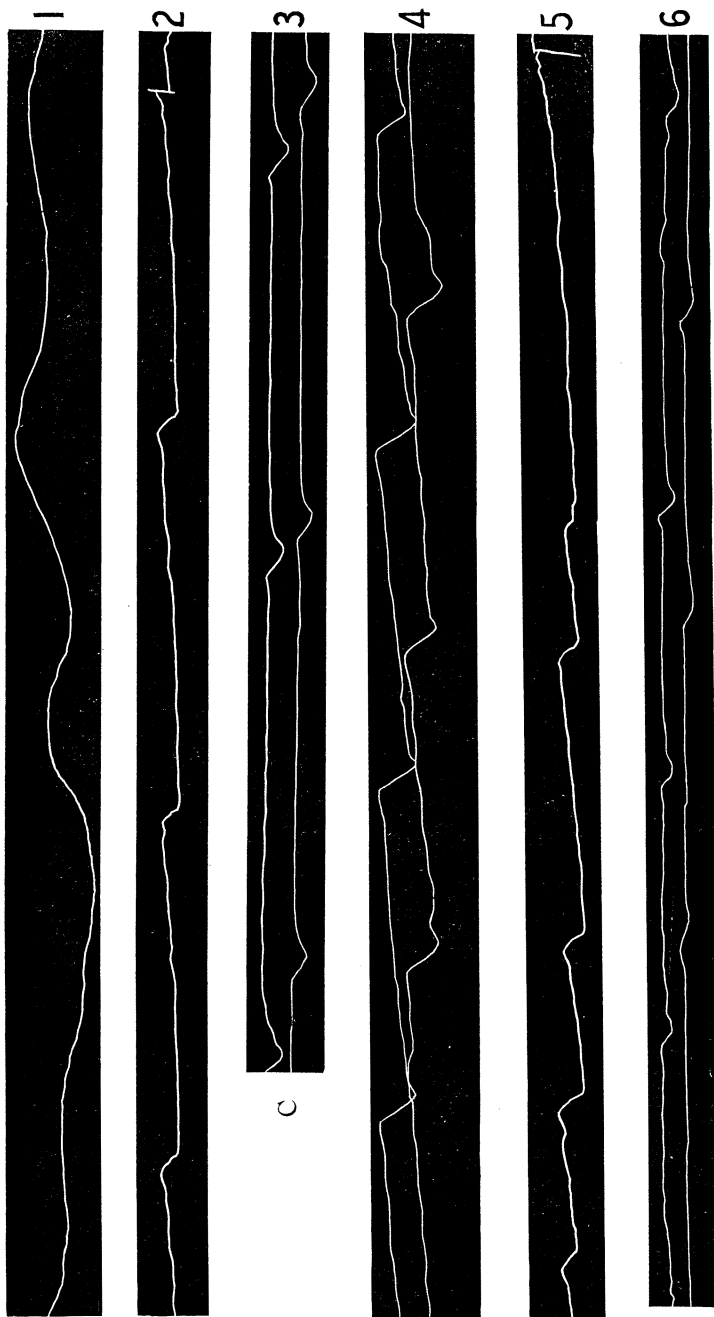
The cases of divided accent are interesting as showing that the unity of the total impression is dependent upon the objective correspondence of the most intense and longest, or at least that they stand in such a relation that they offer no objective hindrance to such a subjective interpretation. The reports of the several subjects show that accent is not dependent alone upon the objective relations of duration, intensity and quality; accent is subjective and changes with the attention. This seems to be the explanation of the facts of substitution. An objective condition which arrests the attention, be it either

through a lengthening of the tone or through increased intensity or a qualitative change or what not, is subjectively stressed or accented, in that it is thereby brought into the focus of attention. The effect of this accent of attention can be increased (*a*) by organic rhythms, sensations vibrating in unison with the attention rhythm; (*b*) by a rhythm in the affective tone. One subject, when asked to inhibit the concomitant movements, reported four distinct elements in the subjective rhythm; (1) gross up and down motions of the body; (2) resistance rhythm, due to attempt to inhibit movements; harder to resist movement in case of high tones; (3) rhythm of attention; (4) affective rhythm, indifferent-tranquil (low tone) and unpleasant-irritating (high tone). Ruling out the second factor, which arose from the special conditions, we have here two rhythms running parallel with the attention rhythm. The subject might also have added another, *i. e.*, the organic rhythm. To be sure, all these factors may not be present, although in the most perfect rhythm they are all found, fused to a total rhythmical perception.

CHAPTER III. MINOR PROBLEMS.







The three plates show respiration curves. Plate *A* gives a series from *R. A.*; Plate *B* a series from *H.*; and Plate *C* a series from *C. D.* The numbers 1-6 are used, in each series, to designate (1) the curve of normal respiration; (2) the curve taken at the time of involuntary grouping; (3) the curve taken at the time of trochaic grouping; (4) that with iambic; (5) that with dactylic; and (6) that with anapaestic grouping. All curves are somewhat marred by scratches made at the time of measurement. They are reduced one-half.

§ 1. *Respiration.* The breathing was registered synchronously with the rhythm. Although the results have been frequently referred to, in the discussion of rhythm, they have not been given in detail. The character of the breathing varied with the rhythm given. The average of several curves for normal respiration of the three subjects, taken at various times during the course of the experiment, is also given for the purpose of comparison with the rhythmic respiration.

R. A.—In her rhythm each syllable had distinctness and individuality, *i. e.*, the syllable was the unit and not the group; this is apparent in her breathing.

TABLE XLIX (a), (b).

The averages for breathing during involuntary grouping.			Averages for breathing during trochaic grouping.		
Expiration.	Inspiration.	Height.	Expiration. a b	Inspiration. a b	Height. a b
.52 sec.	.32 sec.	3.12 mm.	.75 sec. .649 sec.	.23 sec. .285	3.7 mm. 3.1
.498 "	.278 "	2.98 "	.907* "	.233 sec.	2.2 mm.
		* "	1.071* "	.366 "	4.5 "
.475 "	.372 "	4.32 "	1.25* "	.52 "	4.13 "
.384 "	.348 "	4.13 "	.709* "	.238 "	3. "
.448 "	.294 "	2.95 "			
Av. .465 "	.322 sec.	3.5 mm.	Av. .984* "	.373 sec.	3.45 mm.

Series (3) given in full, p. 506, above.

TABLE XLIX (c).

Averages for breathing during iambic breathing.

Expiration. a b		Inspiration. a b		Height. a b	
.571 sec.	.552 sec.	.335 sec.	.335 sec.	2.62 mm.	1.98 mm.
.597 "	.603 "	.37 "	.515 "	3.5 "	4.5 "
.49 "	.464 "	.3 "	.323 "	3.12 "	3.2 "
.61*		.315*			2.63*
Aver. .533 sec.	.506 sec.	.335 sec.	.391 sec.	3.06 mm.	3.24 m mm.

*There are two syllables to an expiration.

In the involuntary grouping (with the exception of series 3, which was given in full, as *R. A.*, there fell into a trochaic grouping) the average expiration lasted about .5 sec. and the inspiration .3 sec. The mean height was 3.5 mm.; each syllable corresponded to an expiration and each pause to an inspiration. With the trochaic grouping, an expiration lasted during the time occupied by two syllables and the intervening pause, giving an average duration of .984 sec. for the expiration; the inspiration, corresponding to the pause at the end of the group,

TABLE XLIX (d).
Averages for breathing during dactylic grouping.

	Expiration.			Inspiration.			Height.		
	a	b	c	a	b	c	a	b	c
	.63 sec.	.528 sec.	.559 sec.	.256 sec.	.283 sec.	.328 sec.	3.1 mm.	3.6 mm.	3.9 mm.
	.554 "	.503 "	.548 "	.3 "	.273 "	.352 "	2.71 "	2.2 "	2.5 "
	.554 "	.407 "	.473 "	.258 "	.317 "	.463 "	2.34 "	2.39 "	3.5 "
	.49 "	.463 "	.584 "	.321 "	.287 "	.253 "	3.62 "	3.06 "	3.47 "
	.515 "	.406 "	.497 "	.276 "	.281 "	.306 "	3.37 "	3.25 "	4.18 "
Aver.	.548 "	.481 "	.532 "	.282 "	.288 "	.342 "	3.03 "	3.1 "	3.5 "

TABLE XLIX (e).

Averages for breathing during anapaestic grouping.
(Breathing for several series was the same as for involuntary grouping. Others are given.)

	Expiration.			Inspiration.			Height.		
	a	b	c	a	b	c	a	b	c
	.646 sec.	.64 sec.	.72 sec.	.33 sec.	.37 sec.	.49 sec.	2.8 mm.	2.7 mm.	4.7 mm.
	.532 "	.628 "	.643 "	.228 "	.246 "	.609 "	—	—	—
Aver.	.589 "	.634 "	.681 "	.279 "	.308 "	.549 "	—	—	—

had a mean duration of .373 sec. The average height did not vary perceptibly from that given for involuntary grouping. We have in the case of the trochee the only instance, with the exception of one iambic reading, in which one expiration had a duration equal to that of a group in the spoken rhythm. It is also noteworthy that the trochaic was the only grouping in which *R. A.* succeeded in giving a completely unitary character to the group. Here we have an illustration of the effect of the rhythmic perception upon the breathing; *i. e.*, with the

trochee, the most natural form of rhythm, the group was perceived as an unit, and the breathing took on the same character; with the iambus, dactyl and anapæst, the breathing curve is of a peculiar character. Here, although an expiration corresponded to each syllable and an inspiration to each pause, wherever there is a subordination of syllables to the group it is shown in the respiration curve; for example, in the dactyl each group of the respiration curve is divided into three smaller parts, in which the longest expiration corresponds with the first syllable, the shortest expiration and least excursion with the second syllable, and the medium long and high with the third. A complete failure to produce the rhythm was shown quite as clearly on the breathing curve as on the rhythmic, by a primary type of breathing. The respiration curves for the iambus, dactyl and anapæst bear evidence in the case of *R. A.* to an imperfect perception of rhythm; while the relation of the syllables to each other was perceived, the whole was not an object of immediate time perception as with the trochee. We have rather a series of perceptions which are compared with one another.

TABLE L (a).—*H.*
Averages for breathing during involuntary grouping.

	Expiration.	Inspiration.	Height.
	6.13 sec.*	.3 sec.	16. mm‡
	3.9 " *	.3 " "	9.7 " "
	4.6 " *	.268 " "	? " "
	4.55 " "	.319 " "	4.68 " §
	2.66 " "	.291 " "	9. " "
	4.268 " "	.3 " "	8.66 " "
	3.918 " "	.288 " "	6.75 " "
Average,	4.289 sec.	.295 sec.	7.46 mm.

*Another subject.

‡The excursion of the tambour was changed after this series.

§The first record for *H.*

TABLE L (b).
Averages for breathing during trochaic grouping.

	Expiration.	Inspiration.	Height.
	4.2 sec.	.266 sec.	6.33 mm.
	3.506 " "	.293 " "	4.1 " "
	4.86 " "	.308 " "	6 " "
	4.436 " "	.325 " "	4 " "
Average,	4.35 sec.	.298 sec.	5.8 mm.

TABLE L (c).

Averages for breathing during dactylic grouping.

	Expiration.	Inspiration.	Height.
	5.175 sec.	.15 sec.	6.833mm.
	4.62 "	.286 "	7.83 "
Average,	4.897 sec.	.208 sec.	7.331 mm.

TABLE L (d).

Averages for breathing during iambic grouping.

	Expiration.	Inspiration.	Height.
	3.9 sec.	.25 sec.	3.8 mm.
	4.61 "	.283 "	3. "
	4.75 "	.3 "	4. "
	4.05 "	.306 "	3.25 "
	4.63 "	.319 "	3. "
	4.05 "	.34 "	8.7 "
Average,	4.28 sec.	.299 sec.	4.425 mm.

TABLE L (e).

Averages for breathing during anapæstic grouping.

	Expiration.	Inspiration.	Height.
	6.195 sec.	.287 sec.	7.75 mm.
	4.683 "	.325 "	7.83 "
	3.6 "	.31 "	3.2 "
	4.06 "	.356 "	3.25 "
Average,	4.633 sec.	.319 sec.	5.51 mm.

TABLE LI (a).—C. D.

Averages for breathing during involuntary grouping.

	Expiration.	Inspiration.	Height.
	5.5 sec.	.625 sec.	8.25 mm.
	5.95 "	.45 "	10.55 "
	6.108 "	.325 "	12.8 "
	5.958 "	.241 "	10.6 "
	6.38 "	.333 "	8.5 "
	5.878 "	.561 "	11. "
	4.58 "	.231 "	11.25 "
Average,	5.765 sec.	.395 sec.	10.41 "

TABLE LI (b).

Averages for breathing during trochaic grouping.

	Expiration.	Inspiration.	Height.
	1.336 sec.	.292 sec.	12.4 mm.
	1.524 "	.328 "	3.8 "
	2.247 "	.278 "	3.2 "
	1.98 "	.209 "	2.8 "
Average,	1.771 sec.	.276 sec.	(5.39)mm 2.76 mm

TABLE LI (c).

Averages for breathing during iambic grouping.

	Expiration.	Inspiration.	Height
	5.8 sec.	.4 sec.	4.75 mm.
	4.05 "	.275 "	3.75 "
	7.5 "	.366 "	3.8 "
	4.95 "	.375 "	4.5 "
Average,	5.57 sec.	.354 sec.	4.2 mm.

TABLE LI (d).

Averages for breathing during dactylic grouping.

	Expiration.	Inspiration.	Height.
	4.45 sec.	.25 sec.	6.5 mm.
	4.89 "	.342 "	5. "
	4.99 "	.312 "	4.5 "
	4.27 "	.318 "	6.33 "
Average,	4.65 sec.	.305 sec.	5.58 mm.

TABLE LI (e).

Averages for breathing during anapæstic grouping.

	Expiration.	Inspiration.	Height.
	2.305 sec.	.308 sec.	4.05 mm.
	3.36 "	.3 "	5.6 "
	2.11 "	.27 "	2.9 "
	2.704 "	.229 "	2.5 "
Average,	2.622 sec.	.276 sec.	3.53 mm.

TABLE LII.

Averages for several series of normal breathings.

	Expiration.	Inspiration.	Height.
C. D.	2.175 sec.	1.51 sec.	7.65 mm.
H.	2.165 "	1.975 "	14.25 "
K. A.	.96 "	.72 "	2.89 "

With *H.* and *C. D.*, the perfect correlation between the rhythms of speech and of respiration seen in *R. A.*'s reading was not found. One expiration included from six to ten syllables; thus one breathing curve covered several groups. The only difference between respiration during the free readings and the trochaic, iambic, dactylic or anapæstic readings was the greater height of the curve during the free reading.

Comparing these curves with the normal, we find in the case of *R. A.* that the respiration time, both for expiration and inspiration, is shortened, and the height increased. (The trochaic grouping is an exception, but here her breathing curve approximated that of *C. D.* and *H.*) *R. A.*'s normal breathing was very superficial, and became somewhat deeper in speaking. With *H.* and *C. D.*, on the contrary, the expiration time during reading of the rhythms is considerably longer than the normal, while inspiration is markedly shorter, and height is very noticeably decreased. The change in *R. A.*'s breathing is an example of the general rule that exercise increases the depth and frequency of respiration. The reason that her rhythmic respiration curve is thus typical of the respiration curve for exercise is probably to be accounted for by the fact that the perception of the rhythm as such had slight influence upon the respiration, *i. e.*, the purely physiological factors present in increased activity were the important elements. But with *C. D.* and *H.* this general principle is completely neglected. We must look for some other factor which has reversed the results. This factor we can reasonably presume to be an important element in the perception of the rhythm, since it occurs only in the case of *H.* and *C. D.*, with whom the perception of rhythm is much more perfect than it is with *R. A.* It is undoubtedly a psychological factor, since there has been no change in the physiological condition that would bring about such a startling reversal of the general rule. The curve appears in the main to agree with that given by Lehmann¹ for strongly concentrated attention. In general, then, the lengthened expiration and decreased height of the curve would seem to indicate an attentive state in which the attention was directed forward. The great regu-

¹ Die körperlichen Äusserungen psych. Zustände, 1899, pp. 68 ff.

larity of the curve, and the subnormal height, point to the absence of any affective element. Lehmann, in his discussion of expectant attention, or in other words an attention which is directed forward ('expectant' has been used so frequently to connote a conscious state with a strongly affective tone that it seems well to avoid the term in this case) says: "Zu den Affekten oder Stimmungen kann man diesen Zustand nicht rechnen, weil er im Allgemeinen nicht gefühlsbetont sein wird." Bolton's Subject D. was inclined to refer all his time judgments to what he considered his natural rate of breathing; but rate of breathing, as experiments have shown, is not a constant factor in terms of which a judgment could be made; it is much more likely to take on the tempo of the rhythm than *vice versa*.

One might perhaps seek to explain the peculiarities of a respiration curve by the necessary changes accompanying regular speech; but we should hardly in that case find such pronounced individual differences in the curves. Moreover, it has been found by others that the hearing of rhythm affects the breathing. One subject, in the series taken with adults, said upon hearing Disc 5 immediately after the two-group that she found her breath coming faster as she listened to it.

No record was taken of the changes in the pulse, but it is probable that the change in the pulse follows from the change in breathing, and is therefore of secondary importance. Bolton's Subject 4 reported that the click which came nearest to the heart-beat seemed always to correspond with it, and that those coming between formed a group.

§ 2. CONCOMITANT MOVEMENTS.

There are other movements which, under certain conditions, frequently accompany the hearing or production of a rhythm; but these have neither the constancy nor the universality of the respiration and pulse rhythms; yet, as their presence or absence together with other characteristics of rhythmical grouping bears on the general question of the nature of rhythmical perception, they have been noted, together with the conditions under which they arose. Movements of this sort were scarcely ever present in the experiment with the microphone, while they were very frequently present in the freer readings of Method I. They were also remarked by nearly all of the adult subjects upon certain occasions. Many of the movements were apparently closely connected with the breathing.

In the reading of the German children the accented syllable was often spoken with a strong expiration which threw the head forward. Nearly all of the concomitant movements of the German children were of this sort. As they were closely con-

nected with the breathing, they could not be classed in the same category with those movements which are not necessitated by speech, but are clearly the response of the body to the rhythm. For example, tapping with the hand or foot.

TABLE LIII. (a).
Concomitant Movements of the German Children.

	Expiratory.	Pendular.	Upward.
Trochee.	27	6	7
Iambus.	28	3	3
Dactyl.	20	6	7
Anapæst.	26	6	4

Although the movements in far the greater number of cases were merely expiratory, there were frequent occurrences of a pendular movement; also a raising of the body, which was always found together with a rising pitch. In this connection it is to be noted that Subject I. M. found the tendency to movement stronger upon hearing the high tones than the low. F. W. also said that there was an involuntary twitching of the eyelids upon hearing the high notes.

The movements of the American children were greater in variety, freer, and less obviously the result of changes in respiration.

TABLE LIII. (b).
Concomitant Movements of the American Children.

	Expiratory.	Pendular.	Upward.	Nodding of head.	Foot and hand.
Trochee.	8	20	13	43	8
Iambus.	10	13	22	31	8
Dactyl.	5	13	13	48	9
Anapæst.	4	2	23	25	6

Absence of movement was generally correlated with imperfect grouping; only two apparent exceptions were noted in the total number of readings for all classes and grades.

Adults, when pendular movements were present, frequently spoke of an association with the clock. Bolton notes the same fact.

What is the character of these concomitant movements? All, except those directly resulting from respiration, are unnecessary to the motor rhythm, and more emphatically so to the sensory. A few, such as the pendular, seem to be due to associations with external objects or with movements of the body. One fourth grade boy, when told what he was to do, was reminded of the movement of beating time. Subject W. M. found that he accompanied the auditory rhythm with movements of

the muscles of the throat, and that during the course of the hour the throat tired noticeably.

There are other concomitant movements which are not so readily subsumed under the principle of association. They seem rather to be of the nature of diffusive movements due to excessive excitation. Lehmann¹ explains them thus:

“Es liegt nun einmal in der Beschaffenheit der Nervensubstanz selbst, dass jede hinlaenglich starke Reizung eines Sinnesnerven eine Bewegung hervorruft, die sich nach dem übrigen Teilen des Nervensystems fortpflanzt. Diese Fortpflanzung, Irradiation, kann im entwickelten Bewusstsein durch willkuerliche Hinrichtung der Aufmerksamkeit gewöhnlich in bestimmter Richtung geleitet werden; ist der Reiz aber zu stark, oder tritt er so plötzlich ein, dass die Aufmerksamkeit nicht sogleich die richtige Richtung einschlagen kann, so wird die Irradiation wahrscheinlich nach allen Seiten vorgehen. Trifft die Bewegung dann die motorischen Zentren, so ruft sie eine vermehrte Innervation mithin eine Kontraktion der mit dem betreffenden Zentrum verbundenen Muskulatur hervor.” Are these movements, both the associative and the diffused, of the nature of expressive movements, or are they to be regarded as means by which a difficult activity is reinforced? The facts observed would bear out either of these presumptions. One first grade boy failed on the complex forms, returning every time to a primary rhythm. We asked him to accompany the spoken rhythm with a clapping of the hands, and he succeeded in producing a dactylic rhythm with marked time and intensity differentiations, but 12 sec. slower than the reading he had previously given. F. W. moved her fingers to the rhythm, in order to place the accent when she was not sure of it. W. M. says: “When attention began to flag there was a tendency to keep the time by bobbing the head.” I. M., very rhythmical and prone to accompany all sensory rhythms with some bodily movement, when asked to inhibit them and notice the effect on the rhythm, found that the rhythm was much obscured; but he was not sure whether the obscuration arose indirectly, through the focusing of the attention upon the inhibition of the movements instead of upon the rhythm, or directly, as a consequence of their inhibition. On another day he reported: “I observed a sidewise movement of the head. I think it was by this equal pendular movement that I judged the duration. I also observed that by stopping the movement the rhythm disappears more than on any other occasion.” (With the Disc employed the tones were all of equal duration, intensity and

¹Die Hauptgesetze des menschlichen Gefühlslebens, Leipzig, 1892, p. 292.

pitch; thus the rhythm was entirely subjective.) Bolton's subjects found difficulty in maintaining the grouping if they restrained these movements.

On the other hand, the children do not appear voluntarily to accompany the spoken rhythm with movements of this nature until they have acquired considerable facility in producing the rhythm.

Miss Smith¹ makes an interesting inference with regard to the concomitant movements. She believes that the reason we have come, in our civilized state, to pay less attention to the rhythm and more to the content in operatic music is that we sit and listen, and do not move with the rhythm. She thus makes movement the primary factor in rhythmical perception. Meyer² also believes that rhythm can be directly sensed only through bodily movement. Meumann (p. 261) regards the relative importance of the different modalities for rhythmical perception as determined by their relation to time estimation. The closer their connection to time estimation, the greater is their importance for rhythmical perception. The most important in that case are the auditory sensations, since they are almost exclusively the source of time estimation. The movements, then, are much less important for the perception of rhythm, since they also serve us in estimating spatial relations; and least of all in importance are the visual sensations, since they have little connection with time estimation. But the weight of evidence from the facts of introspection and observation does not bear Meumann out in this respect. Subjects have been found, who, while unrhythmical, were able to estimate time most accurately. Cf. Miss Smith.³

Several primary teachers were questioned as to how the children learned new songs. The answers were unanimous that the children first learned the tempo by the beating of time with hands or feet. Wundt⁴ says: "Von unserer Bewegung her, in der wir das Rhythmische am frühesten finden, nennen wir daher den Rhythmus überhaupt eine nach genau bestimmtem Mass fortschreitende Bewegung. Aber in der Feinheit, mit der es die Schritte der rhythmischen Bewegung auffasst, übertrifft dann unser Ohr weit die ursprünglichen Bewegungsempfindungen." Buecher,⁵ after his exhaustive study of primitive music, concluded: "Ohne rhythmische Körperbewegung kommt der Gesang bei diesen Völkern überhaupt nicht vor." In the primitive dances, as well as those of children, where the

¹ *Op. cit.*, p. 297.

² *Beiträge zur deutschen Metrik*, '97.

³ *Op. cit.*, p. 289.

⁴ *Grundzüge*, II, p. 91.

⁵ *Op. cit.*, p. 44.

rhythm of the dance, the clapping of hands, are combined with rhythmic sounds from an instrument, the acoustic rhythm can be regarded as secondary to the rhythmical bodily movements.

There is also an apparent priority in the development of the different rhythmical movements. The clapping of hands and stamping of feet are earlier than rhythmical speech. None of the American boys of the first grade could succeed in producing a rhythm more complex than the trochee. Some of them failed even in that. Four out of five of these boys were present on the day that we tested them on ability to clap the same rhythms, and also the power to keep a given tempo in marching.

R. cannot keep time in marching, although he claps all the rhythms successfully.

E., colored, marches in perfect time; has no difficulty in clapping any of the rhythmical forms.

S. succeeds for a while in keeping step, then misses it; succeeds with trochaic and iambic, but fails completely with dactylic and anapaestic forms.

H. marches in perfect time, and gives all the forms without the least hesitancy. This is in striking contrast with his inability to group the syllables in the same rhythmical order.

Hancock,¹ in a study of motor ability, tested one hundred and sixty children from five to seven years of age on ability to beat time. They were all successful with double time; treble and quadruple were more difficult; but all save fifteen were successful in beating these. As not more than two minutes were taken for each test, it seems reasonable to suppose that with ten or fifteen minutes of careful training all could succeed. Buecher² says: "Der Bewegungsrhythmus ist also die Ursache des rhythmischen Verlaufs der Sprachlaute, und wir dürfen vorläufig annehmen dass Letzterer ohne Ersteren möglich ist." Later, Bücher acknowledges that the gap between rhythmical movements and rhythmical speech is too wide to make it probable that the latter was derived solely and directly from the former. He therefore presumes that rhythmic speech arose partly as an imitation of the regularly recurring noises made by industrial implements (p. 308). It is difficult, however, to see wherein a causal connection between the two can be made out. On the contrary, it seems more probable that the larger rhythmical movements precede rhythmical speech, only because in the one case the co-ordinations are grosser, in the other finer and more complicated. The rhythmical nature of both resides in the regularity with which all bodily movements tend to follow one another in a healthy organism.

¹ A Preliminary Study of Motor Ability, *Ped. Sem.*, III, p. 18.

² *Op. cit.*, p. 55.

The presence of rhythmical movement does not, as Meumann has pointed out, warrant the presumption that the rhythm as such is perceived; while motor rhythm is physiologically conditioned, its perception would involve other and conscious elements.

Ewald finds an anatomical basis for the close connection of auditory and muscular rhythm in the two functions of the labyrinth; hearing, and the keeping of the muscles of the body in tone.¹

§ 3. THE RHYTHMICAL AND UNRHYTHMICAL SUBJECTS.

It is common to separate all persons into two classes, the rhythmical and the unrhythmical. Such a clear cut division is not warranted by the experimental facts. Numerous degrees in the perfection of the motor rhythm have been shown, as well as indications that there are the same gradations in the perception of rhythm; from that of a young child, who does not perceive rhythm except as a series of movements and these loosely connected, to the older children, whose perceptions were very complex, involving not only numerous bodily rhythms, but auditory and affective rhythms as well, all fusing to a total perception; an unitary impression arising from the manifold of sensation.

The Unrhythmical Subject. Perception of rhythm may fail because of a physiological defect, auditory or motor, or due to imperfect connection of the auditory and motor centers; or it may be psychologically conditioned. An inability to control the attention, or to compare sound with sound or movement with movement, might cause failure in perception of rhythm. Still, this does not seem to exhaust the possibilities by which failure to perceive rhythm may arise. Two boys of the upper grade, one German, the other American, were decidedly unrhythmical. By this we do not mean that they were totally unable to perceive rhythm, but that the forms which they produced lacked the unitary character and the completeness of those produced by others. Yet they were characterized by their respective teachers with the phrases "denkgründlich" and "reasons everything out." Clearly in this case perception of rhythm was not a function of general intelligence. When, however, we consider the direction of attention which has been found necessary, in order that the subjective rhythm may arise, it becomes possible to explain these cases. In the subjective grouping, there is always a surrender of the attention to the series of sounds not as separate but as successive. With these

¹ Ewald: Untersuchungen über das Endorgan der Nervus octavus: Wiesbaden, '92. Quoted by Meumann, p. 261.

boys, it is probable that the attention was not directed upon the succession of sensations but upon the reason for the experiment. Such a critical, analytical state of mind was destructive of the rhythm.

At the present time we are testing a student who shows certain abnormalities in the perception of sensory and motor rhythm. The experiments are not completed. They are (1) a test of the subject's perception of the series of auditory rhythms (the same as given to the normal subjects), upon which he reports; (2) a test of ability to tap certain required forms, the intensity and duration of which are registered by means of a transmitting tambour upon the kymograph drum; (3) a combination of the first and second tests. The subject reacts to the auditory sensations as they are given. The reaction in this case is registered upon the drum for comparison with the objective rhythm given by the disc.

§ 4. HOW DOES PERCEPTION OF RHYTHM DIFFER FROM ANY OTHER PERCEPTION OF SUCCESSIVE STIMULI?

1. It appears to be a phenomenon characteristic of but two modalities, audition and movement. 2. The sensations must follow one another regularly and within certain time limits, the upper of which, .1 sec., is the average rhythm of the cortical cells.¹ The lower time limit for perception of rhythmic succession, 1 sec., is near the lower limit of the organic rhythms; and the most favorable rate, between .3 and .6 sec., corresponds to the natural rate of certain bodily rhythms.² These organic rhythms cannot be regarded as sources of the perception of rhythm; they do, however, make a fusion of the attention and organic rhythm, characteristic of the rhythmical perception, possible. 3. We compare the sensations in the series as to stress. Stress may be objectively brought about by temporal, intensive or qualitative changes,—in short by any change which marks or differentiates one member of the series from another. We judge of stress by the claim that it makes upon the attention. It may be subjectively brought about by a regularly recurring increase of attention. 4. For a comparison of two or more members of a series, it is necessary that they fall within the bounds of immediate time perception. One group corresponds to one pulse of attention, and the regularity of the subjective rhythm is due to the regularity with which the pulses of attention succeed one another. When several groups can be reproduced as a whole, they may be said to fall within the limits of immediate time perception. 5. The peculiar effectiveness of rhythmical perceptions arises from their tendency to set up sympathetic vibrations over the whole body,

¹Text Book of Physiology, edited by E. A. Schaefer, 1900. Vol. II, p. 708.

²*Op. cit.*, p. 2690.

more especially from their reinforcement by organic sensations. These sensations of like phases from the different modalities fuse to a total perception. The alternation of these perceptions we term a rhythmical perception. A perception of rhythm, then, is never a perception of successive sensations, but a perception of successive perceptions, each of which arises from a fusion or summation of sensations coming from different sense continua, but whose vibration times have like phases. 6. Because of the organic rhythms, the perception of rhythm is regarded as peculiarly subjective. We are ordinarily accustomed to refer a complex of sensations to an external object; but with rhythm the sympathetic bodily vibrations cause us to regard it as more subjective. 7. The unitary character of a rhythmical group is dependent upon its unity for perception. This is dependent upon a subordination among the parts. The greater the unity for perception, the greater is the effectiveness for reproduction. Cf. Hoeffding:¹ "The more gradations, the more definitely stamped features and relations a mental state exhibits, the better it can be recalled to memory." 8. The limit of the possible number of separate elements in a group is determined by the limitations of the intensive sensible discrimination. 9. Introspection does not warrant the position of two hypothetical forces, one directed forward, the other backward; or the presence of alternate feelings of strain and relief. What we do find by introspection is a constant forward direction of the attention. The apparent discontinuity in a rhythmic series is conditioned by the discontinuity in the successive acts of attention. The normal span of an attention wave varies with the unity and continuity of the object of perception. "Er steigert sich mit zunehmendem Sinn." "Continua haben ein grösseres Aufmerksamkeitsfeld als Discontinua." The attention rhythm was well characterized by a subject of Zeitler in an investigation of the range of attention.² "Er konnte auch Intervalle, Hebungen und Senkungen der Aufmerksamkeitswelle constatiren. Die Aufmerksamkeit 'hupfte' nach seinen Angaben über die dominirenden Buchstaben in Complexe, auf letzteren länger haftend, als auf den unbetonten Strecken. Bei grösseren Zeiten gleitet die Aufmerksamkeit ruhig über die Reihenfolge der Elemente hinweg." Rhythmical grouping may then be compared to a succession of waves. (*a*) The single group corresponds to one wave—an immediate act of attention. (*b*) The parts of a group correspond to different points in a wave; the accented tone being on the crest. (*c*) The pause is the zero

¹ Outlines of Psy., Eng. Trans., p. 241.

² Tachistoskopische Versuche über das Lesen, Phil. Stud., XVI, p. 408.

point in the advancing wave. It is the time when, in the change of attention, "wir nichts in uns vorfinden," as Eberhardt¹ expresses it. 10. An analytical attention is destructive of rhythmical perception; the function of attention in the perception of rhythms is synthetical. 11. If the single impressions are separated by a greater span than that covered by one wave of attention, each impression stands alone; under regular conditions in this case primary rhythm arises. If the rate is too rapid, then there is no perception of rhythm. There is only a regular rising and falling in the intensity of what approximates a continuous sound. Bolton believes that this is because the rate is too rapid to find muscular expression. It is much more probable that perception of rhythm fails because the rate exceeds the upper limit of the cortical rhythm.

§ 5. THE INFLUENCE OF AN ACCOMPANIMENT UPON TEMPO.

The question of the influence of an accompaniment upon the tempo of the rhythm has been directly studied by Eberhardt (here the accompaniment was instrumental), indirectly by Miss Smith in her experiment as to the effect of rhythm upon work,—the metronome gave the time in this case,—and by Buecher. The latter, in his *Rhythmus und Arbeit*, has given a wealth of illustrative material derived from anthropological sources. He instances not only cases in which rhythm of movement is accompanied by song or instrument, but also cases in which individuals accompany each other. The present results show only the influence upon the time when individuals accompany each other.

Chorus reading. In the first experiment, immediately after the individual readings, the five members of each section were asked to give the different rhythmical forms in chorus.

In general, the time of chorus reading is longer than the average for the individual reading; but there are numerous exceptions, especially in the case of the German children, whose results at first seemed very irregular.

An accompaniment appears to have two functions: (a) regulative, and (b) excitatory. *Regulative:* when an accompaniment serves as a regulator it may either decrease or increase the normal rate. The rate of speed will be increased when the standard or leader has a rate exceeding that of the separate individuals. It will be decreased when the individuals are relatively independent of the leader, *i. e.*, when several could equally well lead. In other words, the rate is decreased in proportion to the uncertainty or irregularity of the standard. The tone of the leader, like the beat of a metronome, sets the pace.

¹ *Op. cit.*, p. 106.

TABLE LIV (a).
Chorus. Boys. American.

TROCHEE.		IAMBUS.		DACTYL.		ANAPÆST.		
Av.	Cho.	Av.	Cho.	Av.	Cho.	Av.	Cho.	
23.02	27.	30.4	30.	*29.5	*24.	*30.7	*20.	I. Class.
24.7	*17.2	26.7	*17.	28.3	17.2	24.1	15.	
21.3	22.5	22.2	*19.	22.5	20.	21.5	20.	
20.9	24.	23.3	*24.	22.8	23.	22.6	22.	
24.1	*16.	23.3	*18.	23.1	21.4	21.7	18.	
22.8		25.1		25.24		24.1		
M.V.	21.3	M.V.	21.6	M.V.	21.1	M.V.	19.	IV. Class.
1.36	M.V.	2.6	M.V.	2.94	M.V.	2.68	M.V.	
	3.8		4.28		2.02		2.5	
15.4	22.	16.7	22.	16.1	20.	15.1	†22.8	
14.7	17.	16.2	17.	15.5	†15.	14.45	18.5	
15.9	18.2	1.49	20.	14.1	19.	13.5	18.	
14.7	21.	15.2	21.5	13.2	20.	14.6	21.	
15.4	18.	15.2	18.	14.5	16.4	13.	17.2	
15.2		15.6		14.6		14.13		
M.V.	21.24	M.V.	19.7	M.V.	18.08	M.V.	19.5	
.42	M.V.	.64	M.V.	.88	M.V.	.68	M.V.	
	2.3		2.2		1.9		1.7	
14.45	18.	14.2	16.	13.2	16.4	11.05	16.4	VII. Class.
12.7	18.	13.1	17.	12.	15.	11.5	13.	
13.	20.	13.9	18.	11.2	17.	11.5	18.	
13.5	14.	12.4	15.	12.	14.	11.6	12.	
15.2	22.	14.5	21.	12.6	20.	12.6	17.	
13.7		13.6		12.2		11.65		
M.V.	18.4	M.V.	17.4	M.V.	16.48	M.V.	15.28	
.77	M.V.	.74	M.V.	.56	M.V.	.38	M.V.	
	2.08		1.68		1.61		2.02	

*Failure to produce rhythm.

†Imperfect.

‡Notice time.

Now if the time of the leader is no faster than that of the other members, there is also slowing of the individual times due to the fact that each waits for the other or for the leader. This is characteristic of the results in general. Miss Smith observed two stone masons working together, and found that though they were apparently working faster, the tempo was in reality slower than when each worked alone. Buecher divides work into two classes, "Arbeit in Gleichtakt" and "Arbeit in Wechseltakt."¹ He defines the function of the first as regula-

¹ *Op. cit.*, pp. 130 ff.

TABLE LIV (b).
Chorus. Girls. American.

Trochee.		Iambus.		Dactyl.		Anapaest.		
Av.	Cho.	Av.	Cho.	Av.	Cho.	Av.	Cho.	
23.1	*18.16	22.3	*20. }	22.4	*17. }	22.	*18. }	I. Class.
18.7	19.	17.5	17. }	16.7	17. }	20.	18. }	
19.4	18.	19.9	18. }	18.6	29. }	19.1	19. }	
17.9	18.	21.2	21.	16.9	18.5 }	17.2	19. }	
21.	18.	20.4	21.	17.1	19. }	17.8	18.5 }	
20.02		20.6		18.3		19.2		IV. Class. †
M.V.	18.23	M.V.	19.4	M.V.	20.1	M.V.	18.7	
1.76	M.V.	1.22	M.V.	1.76	M.V.	1.24	M.V.	
	.32		1.52		3.5		.44	
23.1	26.	19.7	24.5	19.3	21.	21.3	*21.	VII. Class.
19.5	†18.	20.7	19.2	18.5	†18.	16.5	†16.	
16.9	17.	17.5	19.	15.2	†14.2	14.6	16.	
14.6	18.	16.05	17.5	13.7	15.	13.8	†13.	
15.8	16.	17.5	17.5	13.3	16.	14.1	15.	
17.9		18.23		16.		16.06		
M.V.	19.	M.V.	19.5	M.V.	16.8	M.V.	16.2	
2.24	M.V.	1.31	M.V.	2.3	M.V.	2.61	M.V.	
	2.6		1.96		2.1		1.3	
18.8	21.	18.8	19.	16.5	†17.	15.5	19.	
19.1	20.	16.8	19.5	16.1	18.5	15.1	17.6	
18.4	18.5	18.3	19.	15.7	19.	16.	17.	
§19.	†18.	17.5	17.5	15.5	17.	14.3	16.	
17.3	18.	17.5	18.	16.	†15.2	15.2	17.5	
18.5		17.8		15.96		15.2		
M.V.	19.1	M.V.	18.6	M.V.	17.3	M.V.	17.4	
.74	M.V.	.62	M.V.	.24	M.V.	.42	M.V.	
	1.1		.68		1.1		.74	

§ Times of all individuals unusually long.

¶ Here Marjorie and Annie have much quicker time than others. Shows more in chorus.

† There is a lengthening of average time which brings about incongruity quite as much as the shortening of the chorus time.

tive. It holds the company to the same time and calls for an equal expenditure of energy from each of the workers. Though he gives us no data¹ as to the comparative times, we should probably find it slower than the individual times. The work for each individual is in this case increased; he must not only attend to his own, but also to his companions' tempo.

¹ Buecher does not appear to recognize the fact that the use of an accompaniment may bring about a retardation of the normal rate.

TABLE LIV (c).
Chorus. Boys. German.

TROCHEE.		IAMBUS.		DACTYL.		ANAPÆST.		
Av.	Cho.	Av.	Cho.	Av.	Cho.	Av.	Cho.	
26.75	28.	32.25	29.	21.75	25.	24.25	30.	I. Class.
28.2	27.	27.4	25.4	25.9	†23.8	27.5	33.	
28.5	32.	27.6	29.	24.8	†24.	24.1	27.6	
27.81	29.	29.08	27.8	24.15	24.26	25.27	30.2	IV. Class.
M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	
0.72	2.	2.06	2.26	1.72	0.48	1.47	1.8	
20.5	21.	21.	21.5	18.05	†17.	18.75	24.4	VII. Class.
20.2	19.	19.5	20.	18.2	†18.	18.7	21.	
20.	21.	21.8	†20.	18.8	†17.	18.5	†17.4	
20.23	20.5	21.22	20.5	18.35	17.33	18.65	20.9	
M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	
0.26	0.63	0.84	0.66	0.3	0.44	0.10	2.3	
22.8	27.	21.2	26.	19.8	23.	19.6	†18.	
21.5	22.	22.1	23.6	19.33	†18.8	20.2	†16.	
21.08	†21.	19.8	†17.	15.8	†15.4	18.05	†13.4	
22.06	23.	21.03	22.2	18.31	19.06	19.28	15.8	
M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	
0.46	2.33	0.88	3.4	1.67	2.55	0.85	1.6	

Regulation at an increased rate. With the younger children especially, the inherent difficulties of some of the rhythms caused a retardation in the individual time; but when they read in chorus the leader, always the most rhythmical, carried the others along at a rate considerably faster than their natural tempo. The work of each individual was decreased; *i. e.*, instead of being obliged to find the rhythm for themselves, which would involve a comparison, more or less difficult, of a series of perceptions, their attention was directed solely to the tone of the leader. They were thus able to give the rhythm at a rate which would have been impossible to them unaided. The same thing was observed with the older children; for example, the German girls of the seventh grade. The leader read very rapidly and surely; the result was that while the chorus time

TABLE LIV (d).
Chorus. Girls. German.

Trochee.		Iambus.		Dactyl.		Anapæst.		
Av.	Cho.	Av.	Cho.	Av.	Cho.	Av.	Cho.	
27.26	33.	30.3	33.	27.3	‡26.	30.66	34.	I. Class.
32.7	35.	31.7	39.	29.3	33.	30.	31.2	
30.8	30.	29.6	32.	26.3	‡25.	30.	‡27.	
31.7	32.7	30.5	34.66	27.6	28.	30.22	30.7	IV. Class.
M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	
2.	1.7	0.73	2.8	1.1	3.33	0.29	2.5	
22.52	24.	19.84	20.	19.3	19.	19.53	21.	VII. Class.
21.4	‡19.	20.7	‡16.	16.9	‡13.6	17.14	‡16.2	
21.2	‡19.	21.	‡17.4	17.	‡14.	17.6	‡13.	
21.7	20.6	20.51	17.8	17.7	15.5	18.09	16.7	
M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	
0.54	2.2	0.45	1.46	1.03	2.3	0.96	2.8	
20.96	‡17.	20.62	‡16.	17.36	‡17.	16.6	‡11.	
18.76	‡17.	18.7	‡17.5	17.1	17.2	15.5	16.	
19.5	‡19.	18.3	‡16.	15.6	‡16.	15.9	17.	
19.74	17.6	19.2	16.5	16.68	16.7	16.	14.66	
M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	M.V.	
0.81	0.86	0.94	0.66	0.72	0.5	0.4	2.44	

was slower than her own it was faster than the natural time of the other individuals in the chorus. The results which Miss Smith¹ gives for work to the accompaniment of the metronome would fall under this head. The standard in this case had absolute regularity and stability, and served as a director of the attention; thus the majority of the subjects were enabled to accomplish more than when working alone although, as Miss Smith further remarks, the quality of the work suffered. The majority of the subjects preferred also that the metronome should give a time somewhat faster than their normal, rather than slower.

When a rhythmical accompaniment of *constant* tempo is em-

¹ *Op. cit.*, pp. 82, 94, 284, 280.

ployed to regulate a *prolonged* activity, the result is that the total time taken is less than it would have been had the activity been unaccompanied. This case naturally did not arise in the experiment as given here. But Buecher appears to regard it as typical of the affect of the employment of an accompaniment. A quicker tempo, as he believes, results even when the accompaniment possesses no more regularity than that given by a fellow worker. "Der Einzelne lässt die Hände sinken oder verlangsamt das Tempo der Bewegungen, wenn er müde wird. Die gemeinsame Arbeit regt zum Wetteifer an."¹ It is doubtful whether the rhythmical accompaniment would in such a case act as an excitant; and, if regulative in function, whether the *irregular* accompaniment would not really result in a slower tempo even though to the casual observer there might be an apparent increase in rate.

Eberhardt² concludes that an accompaniment shortens the time, although his subjects were inclined to judge the rhythm unaccompanied as more rapid. The illusion follows naturally from the same cause as the shortened time. It is first to be noted that the standard in Eberhardt's experiment possessed the requisite regularity and constancy. The attention was directed upon the tones of the accompaniment; and the musician in place of making a series of time judgments attended only to the tones of the accompaniment as they succeeded one another. Eberhardt's explanation is that "der Musiker spielt ein Musikstück mit der Geschwindigkeit bei welcher die Gefühlswirkung, welche er erwartet, sich am deutlichsten einstellt; an ihr hat er einen Massstab für die Geschwindigkeit." Now if he plays with an accompaniment, the feeling rises more quickly, and thus less time is taken for the production of the piece. The time taken for playing the same piece upon a silent piano is still greater than that taken to play without an accompaniment. This Eberhardt explains as the result of the greater psychological activity involved and the retardation in the arousal of the feelings, in terms of which the player judges the rate of succession. But these instances seem rather to be examples of the increased difficulty in the estimation of time when the number of criteria, in terms of which a judgment is made, is decreased. *The fewer the criteria and the less their constancy, the more difficult is the estimation of time and the slower the rate of succession.*

Excitatory. The chorus reading in this case was always faster than the average time of the individuals. When all difficulty in the production of the rhythms had disappeared, the

¹ *Op. cit.*, p. 31.

² *Op. cit.*, p. 149.

children acted as a spur to each other in their reading. This was true of the German girls of the fourth grade as well as of the American classes upon occasion. The manner of reading was very different from that found in the first instance. The rhythm grew more rapid as they proceeded; there were also evident signs of extreme pleasure, and a noticeable tendency to accompany the rhythms with various movements of hands, feet, etc. It seemed to partake more of the nature of the rhythmical exercises of the primitive peoples. Buecher cites numerous cases of 'Arbeit in Wechseltakt' in which rhythm has this function. Here, he finds that the social feelings, desire to outdo one another, etc., predominate in contrast with 'Arbeit in Gleichtakt' in which the regulative function was most prominent. In these instances, in which rhythm is an excitant, the activity has become automatic and the attention can be freely directed to the pleasurable accompaniment.

CHAPTER IV. THE NATURE OF RHYTHM.

The generally accepted definitions of rhythm emphasize the affective side. Wundt¹ defines it as a complex feeling which can under certain conditions pass over into an emotion. "When the feelings produced by rhythmical impressions become more intense, as is usually the case, especially when the rhythm is connected with sensational contents that arouse the feelings greatly, they become in fact emotions." In this feeling complex Wundt distinguishes two factors, (*a*) partial feelings, and (*b*) the unitary total feeling which is a resultant of the manner of connection of partial feelings. "These partial feelings are here the feelings of strained and fulfilled expectation which in their regular alternation constitute the rhythmical time ideas themselves."² These feelings mediate the grouping of what would otherwise be only a series of disconnected impressions. The feeling of strain or rising expectation (both terms have been used) fills the interval between two successive auditory or tactual impressions; the feeling of fulfilled expectation or satisfaction marks the completion of the interval. Thus rhythm owes its integral nature and essential character to the interplay of these two opposed feelings.

Eberhardt³ criticised Wundt on the ground that introspection did not reveal the presence of these two feelings. In place of fulfilled expectation he found only an absolute emptiness of content ("Bewusstseinsleere"). He also objected to the term "rising" expectation; it is not happily chosen, since expecta-

¹ Outlines, Eng. Trans., p. 169.

² Outlines, Eng. Trans., p. 167.

³ *Op. cit.*, p. 106.

tion, in its usual signification, is directed upon an object. But there is no such direction in the case of rhythm. If expectation is used to connote a feeling resulting from the complex made up of sensations of strain and centrally excited sensations, then the distinction between expectation and strained attention is broken down. He would therefore substitute a "feeling of attention" for the Wundtian term "rising expectation." "Die Qualitätsungleichheit wurde dann darin bestehen dass einmal ein Gefühl der Leere, wenn der Ausdruck gestattet ist, das andere Mal das Gefühl einer bis zu gewisser Spannung zunehmender Aufmerksamkeit vorhanden ist." In addition, under certain circumstances, a weak feeling of activity and of pleasantness may be found; but to these feelings Eberhardt would ascribe a very minor part.¹

We must take exception to the terminology of Eberhardt; what he has really done is to make attention mediate the sensation. The feeling of emptiness is nothing but the period of inattention between the successive waves of attention. Why, then, is it necessary to adopt a questionable terminology to express undoubted facts of introspection? It was, probably, in order to give an explanation for what Eberhardt considered qualitatively unlike experiences, by the introduction of two qualitatively different feelings. But this is unnecessary; for the changing sensations give a sufficient explanation for whatever qualitative differences introspection may find in the perception of rhythm. Moreover, 'feeling of attention' is scarcely a legitimate use of the term. Had Eberhardt omitted the term 'feeling' he would have given a satisfactory explanation of the facts of rhythm as introspection reveals them.

Ettlinger objects to Wundt's use of "strained and fulfilled expectation," (1) because the changing strain sensations are from their great variability an unsuitable basis for the "einheitlichen Gefühlsverlauf." (2) The "feeling of fulfillment" would not sink as suddenly as is demanded by the terms of the theory. (3) The pauses might just as well be awaited as the sounds. For these feelings Ettlinger substitutes two forces, a positive, which presses forward, and a negative, which opposes the action of the first.² "In der Isolirtheit und kurzen Nachdrücklichkeit der einzelnen Schläge; da diese nun aber auch die Träger des zeitlichen Zusammenhanges sind, . . . bilden sie die Ansatzpunkte beider Kräfte." When we attempt to find adequate psychological terms for these two forces, it appears that Ettlinger has only thrown the familiar facts of the oscillation of attention into figurative language; what we really have

¹ *Op. cit.*, p. 106.

² *Op. cit.*, pp. 175 ff.

is an explanation in terms of attention. The positive force, 'fortschreitende Tendenz,' is nothing more than a direction of the attention forward. As Groos¹ says: "Die vorwärtstreibende Kraft aller rhythmischen Wiederholungen, besonders der musikalischen und poetischen Rhythmen, dieses unwiderstehliche Weiterdrängen dem wir uns so willig hingeben, ist Nichts anderes als die immer aufs Kommende gespannte Aufmerksamkeit." And the phenomena which Ettliger explains by the action of the second force are nothing other than the objective and subjective stresses, which those sensations or perceptions receive which become the focus of attention.

Other objections might be urged against the Wundtian definition. (1) Expectation could play no part between successive impressions which follow each other at a rate which would give rise to a perception of rhythm. This objection was raised by Külpe² to the hypothesis that expectation and surprise mediate the estimation of short time intervals. The same objection applies here. (2) If expectation mediated the grouping, it would be hard to explain the distinction between the temporal character of the grouping produced by the younger and the older children; it would be the reverse of what it is, for the incapacity of children to sustain a long suspense would make the rhythm more rapid for the younger than for the older. As a matter of fact, the times of the younger are much slower, the intervals longer. (3) We should also expect, if expectation played any part, that the iambus and anapæst would be shorter than the trochee and dactyl. But the opposite is true. (4) The breathing curve does not show the characteristics of an expectation curve. "Bei der Erwartung, besonders wenn diese als 'gespannte' Erwartung hervortretend ist, wird eine Erhöhung der willkürlichen Innervation nebst einem Spasmus der organischen Muskeln wahrgenommen" (Lehmann).³

The only other recent attempt to define rhythm has been that of Miss Smith⁴ who in the main follows Meumann and Wundt. She defines it as an emotion, "dessen motorischen (und damit zum Theil auch die vasomotorischen) Aeusserungen und Entladungen sich nicht vollkommen frei ergeben können, wie beim gewöhnlichen Affectverlauf, sondern dessen Ausdrucksbewegungen nach einem bestimmten Schema zeitlich und intensiv geregelt sind." While this definition does not add anything that was not implicit in the Wundtian defi-

¹ Die Spiele der Menschen, Jena, 1899, p. 183.

² *Op. cit.*, p. 405.

³ Die Hauptgesetze des menschlichen Gefühlslebens, Leipzig, 1892, p. 312.

⁴ *Op. cit.*, p. 291.

nition, it ignores the perceptual elements, which Wundt does not. Miss Smith goes so far as to declare that rhythm disappears when the affective tone becomes unpleasant.¹

No explanation which makes the affective elements fundamental to rhythm can be satisfactory. (1) Introspection shows that rhythmical grouping can occur in a perfectly indifferent conscious state. This was noted by the subjects of Bolton and Smith as well as by our own. (2) Feelings become blunted by repetition. If then, rhythm originates in the partial feelings, which Wundt makes intermediaries in each and every group, we should expect a gradual weakening of the affective tone of rhythm with prolongation of rhythm; but this is not true. As a rule, the affective tone generally increases for a considerable length of time, especially when organic co-vibrations are set up. (3) The feeling, when present, does not consist of a series of contrasted feelings, such as any theory which makes feeling the intermediary of grouping must presume; on the contrary it runs a comparatively unbroken course of either gradually increasing pleasantness or, when reversed, of gradually decreasing pleasantness. The contrast brought out in grouping is ideational in source. (4) No explanation of rhythm which goes out from the feeling side can successfully explain the limitations which all groupings show (the limitations to the two and three grouping and their compounds). (5) The gradual growth of rhythmical ability and rhythmical perception can be accounted for only on the grounds of its perceptual nature. (6) The characteristics of the affective curve are not present in the rhythmic curve taken by the pneumograph. The curve, as has been shown, is that characteristic of an attentive state. (7) Furthermore, all the phenomena of rhythm can be explained by the facts of perception.

How then are we to account for the presence of feeling? For it is not to be denied that feeling is often an accompaniment of rhythmical perception. In this connection, the data which were given by the adult subjects, as to the affective tone of the rhythms given by the different discs, are interesting.

¹ "Wenn das Gefühl, welches durch taktmäßige Bewegungen erregt wird, nicht angenehm ist, dann ist der Rhythmus (wie wir das Wort gewöhnlich verstehen) nicht vorhanden, sondern vielmehr ein Bewusstsein von Disharmonie und Unbequemlichkeit," *op. cit.*, p. 287. Introspection contradicts this statement.

Titchener (*Experimental Psychology*, Vol. I, Part 2, p. 353) calls attention to Meumann's evident change of view. In Meumann's own work he emphasizes the perception side of rhythm, pp. 272 f., 284, but Miss Smith, whose manner of treatment of rhythm was evidently influenced by Meumann, defines it as an emotion, as the passages above quoted show.

B. B. The regularity of the sounds is pleasant.

I. M. describes Disc 5 as pleasant and enlivening.

S. says that 7 is pleasant, reminds of dance music.

B. B., that rhythm with the forks having an interval of the minor third is pleasanter than with the former forks.

F. W. says "Disc 6 is rather pleasant; it reminds me of calling some one." Disc 9 was unpleasant.

E. P. finds Discs 1 and 7 pleasant by association with sounds of machinery. All the other discs are unpleasant. She says later: "None of the combinations are pleasant; some are even unpleasant; affection seems to have worked off from the combinations which were at first pleasant. While in the case of the combinations at first indifferent, their perception is now unpleasantly toned." With E. P. objectively conditioned rhythms are unpleasant; the pleasantness seems to be due to associations; these are more readily called up with the more flexible forms, *i. e.*, those she can herself arrange.

E. V. B. finds Disc 2 disagreeable, as some borders with straight lines. (The affective tone is here given by a visual association.) She also finds the two-group discs colorless and unpleasant by contrast with the three-group preceding. Disc 2 is pleasant, the high tone particularly so because of the singing quality. In comparing Disc 5 with Disc 1 she says: "It is much pleasanter, brighter and quicker. (1) was heavy."

Unpleasantness arises where the natural subjective grouping is obliged to overcome a strong objective rhythm. E. V. B. found Disc 8 unpleasant for this reason. (8 and 9 for all subjects were less pleasant than 6 and 7. The objective conditions were too strongly marked, there was less chance for the free play of the individual tendencies, and there were often resistances to be overcome.) For this same reason F. W. finds Disc 3 not as pleasant as 2.

The facts brought out by these replies are: (1) Feeling is not essential to the perception of rhythm. E. P., who is susceptible to all of the illusions, finds the rhythm pleasant only when associated with the familiar sounds of the factory town in which she spent her youth. How can a satisfactory æsthetic of rhythm be based of the facts of rhythmical illusion,—the supposition being that subjects susceptible to the illusion take pleasure in rhythm? This is the basal supposition of Ettlenger's whole treatment of rhythm; yet it is not warranted by introspective evidence. The illusions have their ground in the facts of sensation and perception, and not in those of affection. (2) Pleasantness is very frequently of an associative character. (3) In instances where the pleasantness seemed to attach to the rhythm *per se*, the three-group was said to be pleasanter than the two-group because it was 'richer,' 'brighter.' Those succeeding each other quite rapidly were pleasanter than those having a slower rate. Regularity of sound was found to be pleasant. These instances can all be subsumed under the rule that a rhythm which is moderately stimulating is pleasant. (4) In the same connection it is interesting to note what forms were found to be especially unpleasant. These were Discs 8, 9, 3 and 4. Here the objective conditions of the rhythms are very

marked. When the form came in conflict with a natural grouping, the rhythm was unpleasantly toned.

Some writers, as Lipps¹ and Groos,² emphasize the associative factor. But such explanations make the affective tone arise from factors extraneous to the rhythm.

Though the associative feelings are no doubt often present, they do not explain the strong feelings that the perception of rhythm is often able to produce; for example, the cases of ecstasy in the rhythmic dancing of the primitive peoples and in the religious services of the Southern negroes. We must look for feelings which arise from the very nature of rhythm. These can be of two kinds, the feelings that accompany the simple sensations, *i. e.*, the simple sense feelings, and those which arise from the connection of these sensations, the æsthetic feelings. In nearly all perception of rhythm, the simple sense feelings are undoubtedly stronger than the æsthetic. The pleasantness arises from the moderate and regular functioning of the bodily organs and the resulting stimulation of the cortex. A moderately rapid rate of succession was found to be pleasanter than a slow. Pleasantness was increased when movements accompanied a sensory rhythm, *i. e.*, when other centers were excited together with the auditory. Hoeffing³ says: "Any sound naturally affords pleasure merely because it sets in action the organs of hearing. The deafening music of children and savages gratifies nothing but this impulse in the organ toward stronger function."

The great pleasure which children find in rhythm is due to the efficacy of rhythm to set up vibrations in other organs of the body, and the consequent harmonious activity of the several bodily organs. The affective tone increases in proportion as the summation of excitation increases, till a state bordering on ecstasy may be reached. Ecstasy, when it follows upon rhythmical stimulation, is due to a spreading of the excitations to a greater and greater number of centers, till the body and the whole of consciousness are set in co-vibration. At such times the rhythm has become automatic, and the attention is directed solely upon the sensations accompanying the diffused bodily movements.

When an auditory rhythm has become so familiar that the excitation is insufficient to cause diffusion, and the resulting stimulation of the cortex is weak, the rhythm is indifferent.

The rhythm will become unpleasant if the rate of succession exceeds the natural rate of the individual.⁴ When the rhythm

¹ *Ästhetische Einfühlung*, Zeits. Psych., XXII, pp. 441 ff.

² *Op. cit.*, p. 33.

³ *Outlines of Psychology*, Eng. Trans., p. 231.

⁴ Miss Smith notes such a case, *op. cit.*, p. 124.

is too complex to be readily perceived, unpleasantness may also attach to it. The demand made upon the cortex in such a case exceeds its normal capacity for function. Of the same nature is the unpleasantness which arises when an objective rhythm through the lengthening of one tone and accenting of another disturbs the normal activity.

The æsthetic effect of the rhythm is not due, as Wundt remarks, to a summation of the sense feelings, but arises from the manner of connection of these sensations. One arrangement of intensities is pleasanter than another because it increases the unitariness of the total impression and its efficacy for reproduction.¹ The various possible arrangements of the objective factors, temporal, intensive and qualitative, have a greater or less æsthetic value according to the approximation of the resultant impression to a unitary character. Here is another instance of a pleasantness arising from the perception of unity in the manifold. It is doubtful, however, if the pleasantness which children find in rhythm is ever of this type. Generally, they had no preferences as to arrangements. When a truthful report upon the pleasantness of the different rhythms was given, the trochee was commonly preferred because it was easier to get. This was clearly not an æsthetic judgment. The pleasantness of the rhythm arose for them, undoubtedly, from resulting bodily activities.

¹ Cf. Külpe's treatment of æsthetic feeling, *Grundriss*, p. 264.